DOCUMENT RESUME

ED 056 415 24 EA 003 902

AUTHOR Ammentorp, William; And Others
TITLE The Management System. Design Document III for the Midwest Educational Training Center.
INSTITUTION Upper Midwest Regional Educational Lab., Inc., Minneapolis, Minn.
SPONS AGENCY National Center for Educational Research and Development (DHEW/CE), Washington, D.C.
BUREAU NO BR-6-2870
PUB DATE 14 Dec 70
CONTRACT OEC-3-7-062870-3069
NOTE 96p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Data Bases; Educational Objectives; Evaluation; Flow Charts; Individualized Instruction; Information Utilization; *Instructional Systems; *Management Information Systems; *Management Systems; Objectives; *Project Applications; *Regional Laboratories; Research and Development Centers; Systems Approach

ABSTRACT

This document, one part of a project to train personnel for educational development and evaluation, describes a management system for individualized student instruction. Certain objectives are set from which management activities and provisions for data storage and use are inferred. The result is a comprehensive flowchart of the instructional sequence with indications of information sources and utilization. Evaluation procedures for measuring the attainment of management objectives are also treated. Related documents are EA 003 900, EA 003 901, and EA 003 903. (Author/RA)

Design Document III

0-9041

for the MIDWEST EDUCATIONAL TRAINING CENTER

The Management System

Prepared by:

William Ammentorp
Roger Raymond
Vernon Hendrix

Upper Midwest Regional Educational Laboratory
1640 East 78th Street
Minneapolis, Minnesota 55423

December 14, 1970

MANAGEMENT SYSTEM

Table of Contents

Part 1 - THE ABSTRACT

Every instructional effort has some collection of procedures whereby students are brought in touch with training activities and materials. These arrangements have special effects on student and staff members quite apart from the content of the curriculum. The ways in which students are moved through the curriculum expresses objectives which the management system attains by design or, in most cases, by accident.

The pages which follow describe a management system for individualized treatment of student instruction. Cert in objectives are set for management from which management activities and provisions for data storage and use are inferred. The result is a comprehensive flow chart of the instructional sequence with indications of information sources and utilization. Evaluation procedures for measuring the attainment of management objectives are also treated.

Part 2 - OBJECTIVES FOR MANAGEMENT OF INDIVIDUALIZED INSTRUCTION

Innovations in training programs in higher education are usually undertaken from one of several major perspectives. Most often, content is changed to meet a growing knowledge base or new content is added to existing programs to broaden their applicability. A good example of this type of innovation is the Research Training Program launched by USOE in 1967. New content - in the form of quantitative analysis, information management, etc. - was added to traditional statistics courses to formulate the program. As is often the case, the RTP was designed to train persons for new occupational roles - in that instance, roles which were anticipated to exist in educational systems.

A second base for program innovation may be found in the method of training employed. Where new instructional or experential methods have been designed, programs are put forth utilizing such techniques. Generally innovations of this type are limited to Departmental or course level offerings and do not affect total training programs.

Another common base for innovation is the management system used for moving clients through programs. Thus, we may alter the course and credit structure of a program without changing content or method of instruction. It is important to note that although most innovations in this category have been focused on entire student populations it is possible to arrange program management change from the perspective of the individual student.

Every innovation - no matter what its base - creates problems for the institution of higher learning. All dimensions of institutional life may have to be altered to accommodate an innovation having a broad base and wide impact. This paper discusses an innovation in training researchers, evaluators, and developers in education which proposes to develop a program based on all of the above perspectives. It outlines the components of the institution which will have to be altered and suggests decision rules whereby the new program might operate. These latter are sufficiently general so as to make the program of potential utility to a wide range of organizations engaged in training persons for roles in education research, development, and evaluation.

Management Objectives

In this paper we will be primarily concerned with the management system for the proposed program and with accommodation of alternative methods of instruction. This will insure that the resulting design will be of widest use and that it will not be limited to specific content.

The objectives of the program - from the point of view of management system design - are similar to those outlined by Cooley and Glaser (1968), pp. 2-3.

"1. The goals of learning are specified in terms of observable behavior and the conditions under which this behavior is to be exercised.

2. Diagnosis is made of the initial capabilities with which the learner begins a particular course of instruction. The capabilities that are assessed are those relevant to the forthcoming instruction.

3. Educational alternatives adaptive to the initial profile of the student are presented to him. The student selects or is assigned one of these alternatives.

4. Student performance is monitored and continuously assessed as the student proceeds to learn.

5. Instruction proceeds as a function of the relationship between measures of student performance, available instructional alternatives, and criteria of competence.

6. As instruction proceeds, data are generated for monitoring and improving the instructional system."

To this set of objectives we need to add several which are related to the over-all content of the program and to its relationship to the field it serves. Our program must accommodate new employment roles and must have internal controls and measures which will promote evaluation and development of the program itself. These constraints are reflected in the following objectives.

1. Knowledge and skills available to trainees are modular in nature and can be aggregated to meet demands of particular employee roles.

2. Follow-up data on trainee performance on the job is gathered and used to revise and update training program content.

3. Students may enter and leave the program at any point. Enter/leave decisions are controlled by trainee characteristics and desired skill/knowledge outcomes.

4. Certification and/or credit is an optional feature of the program. Decision rules are available to insure wide interpretation of program content across receiving organizations.

5. Student performance - both during training and subsequent to training - constitutes the measurement operation for program evaluation. It also produces a baseline of performance against which instructional innovations can be judged.

These objectives are to be attained by reorganizing instructional and management efforts as presently in force in institutions of higher learning. Part of this reorganization is directed to open options for training which may lie outside of traditional educational institutions. These outcomes are attacked in the pages to follow through the generalized objective of a program design which is based on the eleven objectives noted above and which takes into account patterns of student and resource flow which may be viewed as 'givens' for this specific design.

System Flows in Training Organizations

The starting point for design of a system of instruction which will meet the above objectives is the identification of major flows of persons, materials and information which the training organization operates upon. These flows give us a general input-output model of training depicted in Figure I.

FIGURE I

General Flow Model for
Training Organizations

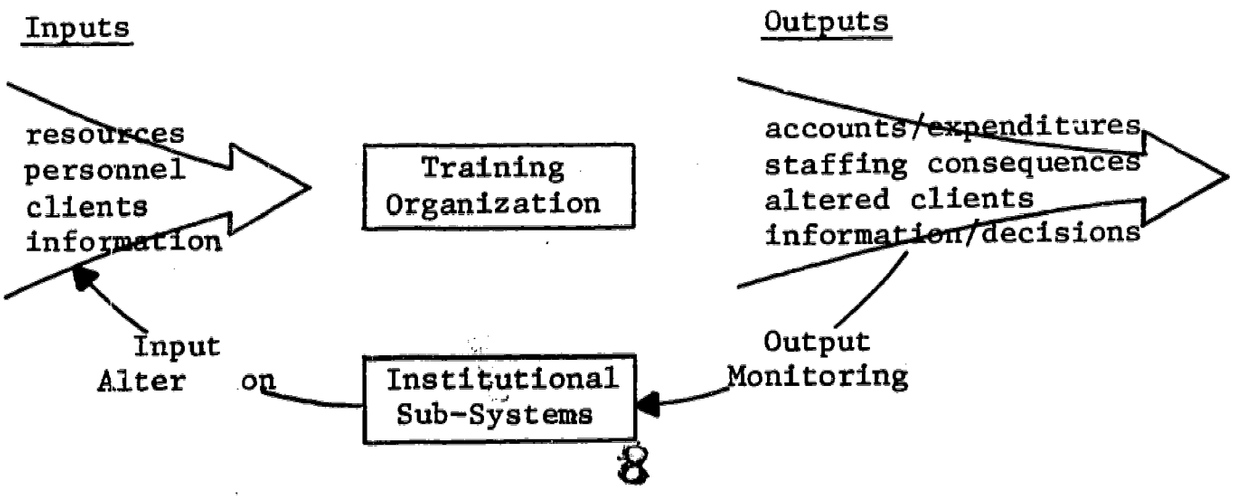


Figure I shows the first limitation placed on our analysis. The program design discussed in this paper is directed entirely toward activities enclosed in the box labelled 'Training Organization'. This means that some significant influences on the instructional program are being left out of consideration. These are decisions made by the Institutional Sub-system (Katz and Kahn, 1966). This sub-system determines the over-all goals of the training organization and makes alterations to inputs to the organization based on social, philosophical and economic concerns. In the case of the training program under consideration, the institutional sub-system has already decided to examine a new training design. Based on the results of design activity, the institutional sub-system may elect to implement the proposed training program. Because this sub-system represents diverse societal influences on training, it may elect to make significant alterations in the objectives of training or to change the institutional framework within which training takes place. For example, a decision to change the location of training from traditional educational organizations to an industrial setting would be representative of the scope of decisions made by the institutional sub-system.

Recognizing the above constraint, we can now proceed to identify flows internal to the training organization, sub-systems which serve important functions in the over-all training effort and parameters which describe different classes of each sub-system. This is done by first addressing the act of instruction

as central to any training organization.

1) The Instructional Sub-system:

The technical activities of the school take place in the instructional sub-system. The resources of the training organization are applied to bring about desired changes in the behavior of students. The objectives of this section of our analysis is to isolate those functions which are essential to the performance of instruction.

It is important to note that the instructional sub-system does not take a given or constant shape. It may vary from the traditional self-contained classroom with heavy use of human inputs to direct interaction between students and curricula through the medium of a computer. Indeed, the objectives for design of the system proposed in this paper suggest basic revisions in present conceptions of instruction organization and management in training organizations. Note that one of the objectives of this design project was to permit change in instruction practice based on data gathered during the process of instruction. This adaptive feature of the design can best be accommodated by specifying the parameters of the instruction effort and noting effects of different parameter conditions on instruction organization and support provisions.

A partial listing of the parameters of instruction would include:

a) instruction technology: instruction may take place via several media - programmed instruction, traditional lecture/discussion and computer based instruction are all possible modes of instruction.

b) staffing ratios: technology employed and student flow identifies a professional staffing ratio for instruction.

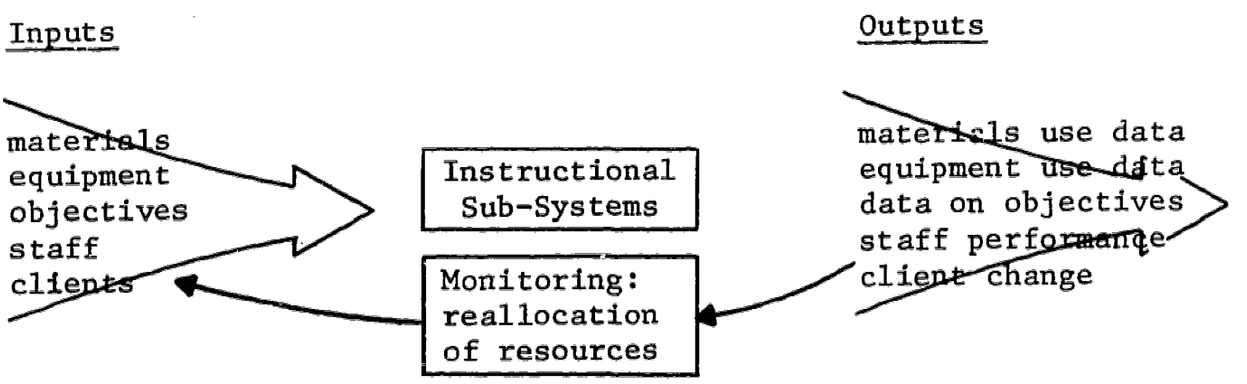
c) student flow: numbers of students per unit time and demographic descriptors of students.

d) physical facilities: configuration of environment related to technology and number of students to be served.

In terms of our general input-output diagram, the instructional sub-system organizes the following flows:

FIGURE II

General Flows for
Instructional Sub-Systems



The box labelled 'monitoring' in the above diagram encloses an important feature of the proposed program. The feedback of data concerning the outputs of training assists in alternating the parameters of instruction or in changing the pattern of resource allocation (Emery, 1969). The diagram also suggests several clusters of activities or functions which must exist in order to continue instruction. These clusters may or may not constitute sub-systems within the training organization. Only detailed analysis will determine their efficacy.

Sub-systems derived from Figure I are analyzed below. The functions they serve are:

a) Materials acquisition, storage and delivery.

b) Objectives generation, modification and organization.

c) Staff recruitment, assignment and evaluation

d) Client delivery and placement.

e) System monitoring and evaluation.

In this analysis we follow the model used above to treat the instructional sub-system. That is, we specify the major flows into and out of the sub-system and list the parameters which determine the organization of the sub-system. For each parameter, we identify the features it must have based on the eleven basic objectives of the instructional management system.

2) Materials Sub-system:

The Materials Sub-system is concerned with identification, procurement, storage, delivery, and replacement of items which are used in instruction. Such items as books, training programs, technical assists, and disposable materials are organized by this sub-system. Some of its parameters are:

a) Inventory Control: In the individualized instruction program, instructional materials must be continuously inventoried and provisions made for signals to reorder depleted materials. Several models for inventory control may be applicable to management system objectives (e.g., Reineck, 1968).

b) Storage and Delivery: The wide range of materials needed to meet our objective of providing instructional alternatives to students demands storage of materials coded to the objectives of instruction. Coding systems must also identify location of materials and procedures for access by students and staff members.

c) Replenishment and Maintenance: A signal for reorder from inventory control should cause an examination of new materials or devices which may be available. Provisions must also be made for maintaining technical assists and for training students and staff members in their use.

3) Objectives Sub-system:

This sub-system collects and organizes the content of instruction. As may already be apparent from our indications of materials parameters, objectives play a central role in integrating the activities of all organizational sub-systems. The file of objectives serves as a method of organizing information used in all organizational sub-systems and as a basis for generating evaluative operations for program monitoring and change. Parameters for the Objectives Sub-systems are:

a) Format For Statement of Objectives: An instructional system directed to individual performance of students dictates concise behavioral statement of objectives. It also demands that measurement operations be specified for objective attainment and that appropriate instructional materials and methods be specified.

b) Objective Storage and Delivery: Objectives must be addressed and stored to permit individualization of student progress through training. The storage design must also permit identification of links among objectives related to program outcomes and to hierarchical dependencies.

These two basic parameters of the Objectives Sub-system are expanded in Part 3 of this paper. There the central importance of the Objectives File to the organization and management of the training program is made apparent.

4) Staff Sub-system:

This sub-system deals with recruitment, assignment, and compensation of personnel employed in instruction. Unlike existing staffing arrangements, this sub-system makes direct links between program content and staffing as is reflected in the following parameters:

a) Staff Recruitment: Flexible to include part time contracted services in program preparation as well as instruction. Recruitment to cover all organizational bases where needed services might be obtained.

b) Staff Competencies: Keyed to program objectives. Matching of competency list to objective needs determines hiring.

c) Staff Re-training: Training skills of staff members listed for possible use in cross training of other staff. Schedules for re-training must also be a part of data output from this sub-system.

d) Staff Compensation: Standard cost analysis of training used to determine staff payment. Payment to be related to productivity of staff on quantitative and/or qualitative basis.

These parameters define, along with those of the Materials Sub-system, a collection of instructional resources directly keyed to the objectives of instruction. Thus, all resource inputs to instruction are identified and controlled by the pattern of objectives brought about in student behavior.

5) Client Sub-system:

The primary support for instruction is derived from this sub-system. Students are identified and program goals diagnosed. Upon completion of instruction, performance data is summarized and evaluation information stored for follow-up of post-training performance.

a) Client Program Expectations: These desired outcomes are derived from a diagnostic procedure administered on program entry. Program objectives are thereby identified for each student.

b) Client Record: Completion of objective signals entry of performance on client record. This record is matched against job specifications generated in consultation with employers to determine hiring of student.

c) Client Account: Fiscal accounting is based on objectives attained. Provisions should be made to allow for flexible patterns of billing and for possible refunds of monies for completion of objectives.

6) Evaluation and Monitoring Sub-system:

Program monitoring is carried out by utilizing the information output from all program sub-systems. This same information is compared against general program objectives and the objectives of the management system to initiate program and/or management modification. For the purposes of this report these two functions have been treated separately at greater length. Management system evaluation appears in Part 7 of this section.

Part 3 - PROGRAM OBJECTIVES FILE: An Information Base for Educational Management

Objectives and the Control of Instruction

A large part of research and development effort in education is currently focused on the design and testing of instructional systems. These systems are developed to meet certain instructional needs and to realize specific objectives related to processes whereby instruction is carried out (Ammentorp, 1970, Part 1). The primary concern of this design activity is that of system management which implies both continuous control as well as adaptability of the system.

In the first place, we recognize that an instructional design cannot meet the requirements of 'system' unless it provides for some control function. This control activity is the representation of the concept of feedback in open systems theory (Haberstroch, 1960). Information is continuously gathered on dimensions of instructional activity and the values of information compared with levels expressive of system objectives. Thus, in traditional educational systems, we might continuously examine average grade points of students in various programs and note these programs where grade point average is below some pre-determined level. Managerial control is then exercised to change some feature of the instructional system to bring grade point average up to desired levels.

In new instructional systems indicators must be found which

can serve the control function provided by the grade point average in traditional educational organizations. This indicator must, like the grade point average, be ived from the instructional process; more specifically, it must express the movement of the student through subject matter or his acquisition of knowledge and skill. In some new instructional designs the primary indicator is one related to the rate at which a student masters instructional goals (Wang, 1968). In others, a measure of acceleration is derived from basic student performance rates (UMREL, 1970). In either case, parameters of the instructional system may be modified (controlled) as a result of information gathered on system indicators.

Many of the new educational designs mentioned above are based on a collection of subject matter objectives which students meet in the course of their training. These objectives generally specifiy some action on the part of the student as well as a standard of performance against which student action can be evaluated (Mager, 1962, Daley & Morreau, 1970, appended). Thus, they have the features of measurement and optimum levels for those measurements which system indicators must possess. By tying control of instruction to measurement of objective attainment of students, we can meet both system needs of momentary control and long range adaptation.

Objectives in Instructional Systems

As we consider structures needed for the statement and storage of instructional objectives, it is appropriate to examine the nature of decisions which must be made in system operation and

adaptation. At the highest level of generality, these decisions relate to (a) the process of instruction and to patterns of student progress and to (b) system output and the degree of correspondence between output and environmental conditions. These classes of decisions are examined below and inferences drawn as to information needs in objective storage.

Consider, first, the problem of matching instructional outputs to conditions of employment and/or articulation with other organizations existent in the environment of our instructional system. Resolution of this matching problem results in program creation - in the sense of content selection for training - or in program adaptation to meet new conditions. It is essentially a process of decomposing environmental opportunities from a level of societal role to that of specific (behavioral) training objectives.

Daley and Morreau (1970, appended) suggest that the process of role decomposition be carried out by preparing a series of objectives of ever increasing levels of specificty. As an example to illustrate this process, consider the training of an instructional programmer. First, the role is stated in terms of the major performance to be exhibited by the incumbent (trainee). This conceptual objective, in turn, is stated in language expressive of the activities of the training program. This educational objective becomes the base for program synthesis. These two steps are shown diagrammatically in Figure I.

Figure I

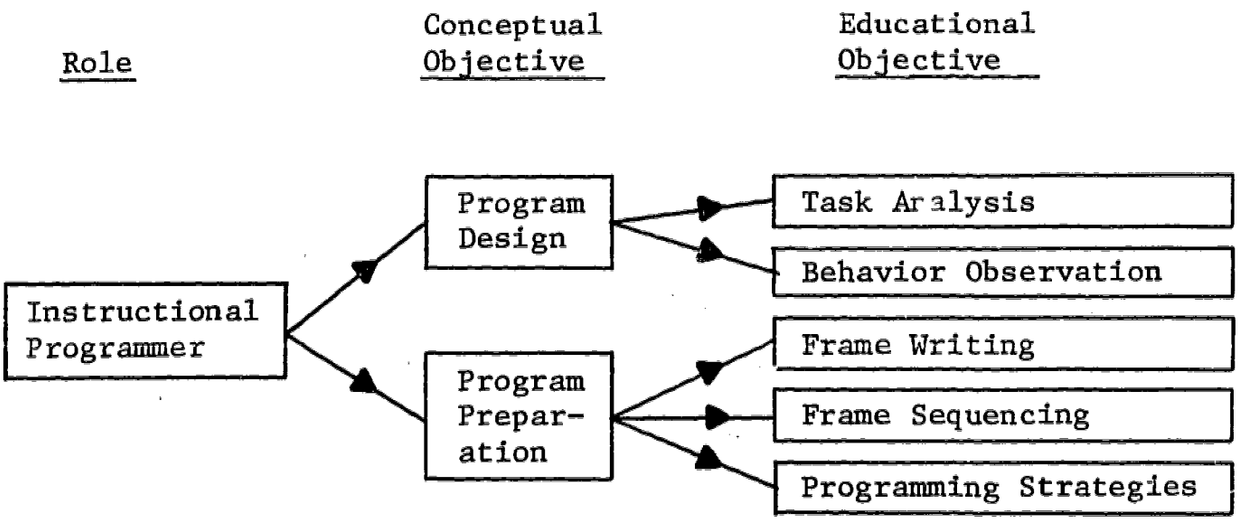
Role Decomposition:
Phase I

Role	Conceptual Objective	Educational Objective
Instructional Programmer	Design and prepare self-instructional training programs.	Training in task analysis, frame writing and behavior modification.

In effect, the social role has branched out into a tree which has as its end points the educational objective or targets which training must meet.

Figure II

Role Decomposition:
Phase I As A Tree



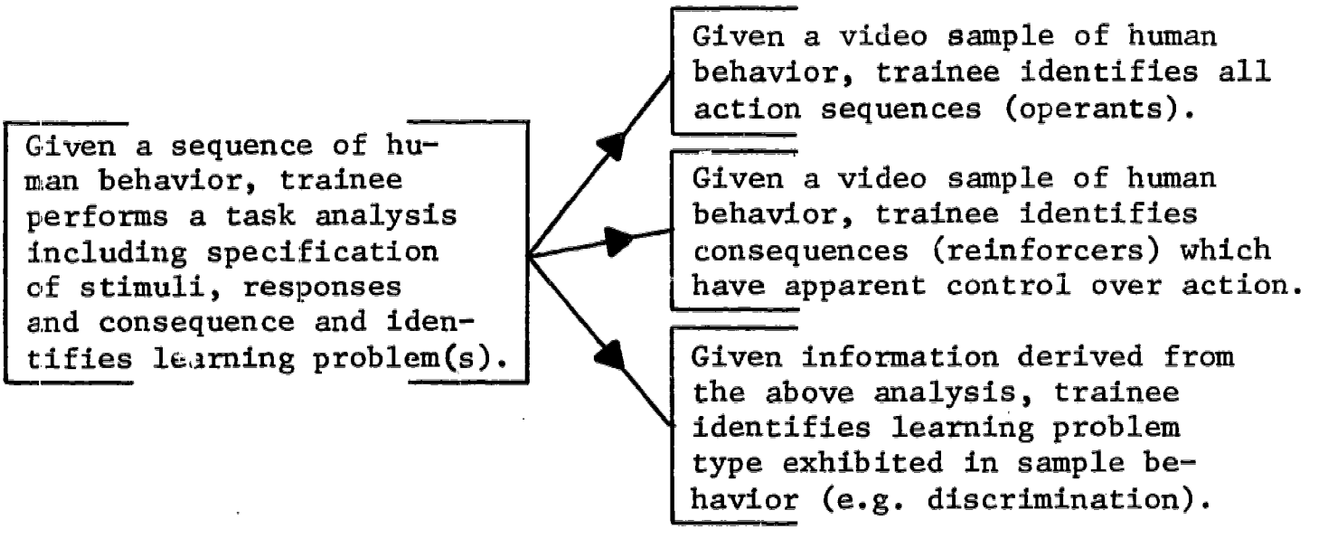
The educational objective derived from the above analysis is further decomposed into instructional and behavioral objectives. These two categories of objectives represent an extension of the tree of interdependencies to finer levels of detail. The instructional objective refers to the terminal demonstration of a coherent cluster of knowledge and skills to be derived from a component or

module of the training program (Silverman, 1966). That terminal demonstration is, in turn, linked to specific behavioral objectives the student must meet in the course of his training.

To continue our programming example, we might find the following instructional and behavioral objectives:

Figure III

Role Decomposition:
Phase II



Thus, we have carried our training objective from the very general to these specific behaviors which will have to be brought up to strength in the trainee. The decisions which follow from information concerning our final collection of behavioral objectives are essentially related to inclusion. We must decide whether a particular objective should be included in total training offerings and secondly, whether a particular objective may be part of the training for more than one role. These decision characteristics set certain constraints on the objective storage file:

1) The aggregation of objectives into roles must permit the inclusion of any given objective in more than one role.

2) Failure to meet any given objective on the part of a trainee should result in restriction of paths to terminal roles.

3) Provisions must be made for adding and/or deleting objectives from the file without destroying potential for role decomposition or aggregation of objectives.

The second class of system decisions has to do with student progress through a training program. These are essentially decisions of sequence. The behavioral objectives in our file are related to one another in one of three ways; a given objective either, 1) preceeds another, 2) is coincident with it, or 3) is indifferent to it (or independent of it). These interactions among objectives derive either from the structure of the subject matter of training or from learning facilitation which may be exhibited across many trainees in the course of program operation.

As a part of the sequence decision category, system managers must also be concerned with the units of work assigned to trainees. Some objectives are likely to require more time and effort on the part of students than others. These differences need to be taken into account in determining work load for students and in awards of credit toward some final degree, if such is available in the training program. Constraints on the objectives storage file derived from sequence decisions are:

1) Each objective must have a unique storage address and no duplicate objectives are permitted.

2) The address of a given objective must reflect sequential dependencies among objectives.

3) Additions of deletions to the file must preserve the above sequence features.

A Format For Statement of Objectives

As a first step in building a file of behavioral objectives for a training program, a standard format is needed for statement of objectives to be considered for inclusion in the instructional offerings of the training system. Building upon the above constraints, we derive the following format.

Figure IV

A Format For Stating
Behavioral Objectives

Address Number: Reflects sequential dependencies among objectives.

Conditions: The conditions under which a trainee is to demonstrate mastery performance.

Action: The specific behavior to be exhibited by the trainee.

Measure: Specification of the measurement operation to be applied to trainee behavior.

Criterion Level: The value of the measurement outcome which signifies mastery performance.

Materials: Known instructional materials which can be used to bring about desired student behavior.

A collection of objectives stated in the above format permits manipulation for the purpose of system decision making. Algerbraic operations can be performed on certain file information to derive summary statistics for program operation and adaptation. Possible operations of this nature are treated below.

Dependency Maintainance System

The following procedure lends itself quite easily, with the aide of a small computer, to the recording of dependencies among the instructional objectives. With an appropriate search routine, a network of tree structure can be generated for any given objective indicated as a terminal objective for a trainee. This network would indicate all prerequisite objectives and permit the drawing of a PERT-type network which would indicate the particular sequential paths a trainee would need to follow in order to reach the terminal objective. This could be easily repeated for any given number of terminal objectives. The system also lends itself to easy maintainance caused by the deletion or addition of objectives to the file, or changes in one of the instructional modules which would result in differing dependencies with other objectives in the file. Finally, if these dependency networks are analyzed in detail every time a change occurs, the task is quite formidable and time consuming. This system permits changes to be made by the simple binary comparison of one objective with other objectives to answer the question, "Is one dependent on the other"?

The basic information for this dependency maintainance (and generation) system would be in the form of a matrix constructed as follows. Given that there are distinct instructional objectives (instructional modules), an "n x n" matric would be created. The binary decision concerning each possible pair of objectives would be represented in the matrix by having one in the elements of a particular

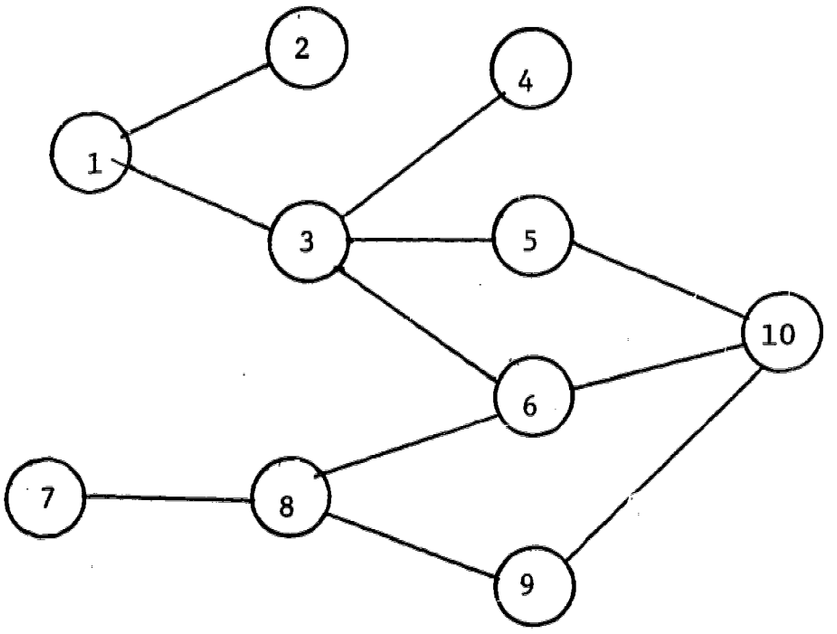
row (corresponding to the instructional objectives) upon which it is dependent, i.e., which must be achieved before the objective being considered. All other elements would be zero, indicating that the associated modules are not a prerequisite. Initially, this would require N(N - 1)/2 binary comparisons to be made. For a large number of objectives, this would be a rather formidable task but could be simplified by grouping the objectives by content or some other technique, which would make unnecessary a large number of binary comparisons. For example, if a set of objectives could be classified into two groups dealing with subject matter A and subject matter B, and these two subject matters are logically independent (such as spelling and arithmetic), then none of the objectives in one set need be compared with any of the objectives in the main set. Since this matrix does not require that the rows and corresponding columns be in any particular order, such arrangements could easily be facilitated. Thus, if we read across a row of this matrix (corresponding to an objective) a one would appear under (illustration) the corresponding column of every objective which is prerequisite to the terminal objective. If we read down a column for a given objective, there will be a one in the corresponding row for each objective for which is prerequisite. In order to add or delete an objective we simply add a row or column or delete a row or column. If changes are made in an instructional module which make changes in the dependencies, we need only make changes in one row and column.

To proceed with this system, we would then square this matrix. If we then scan across a row of the squared matrix, we will find that for every immediately prerequisite objective, the value one in the original matrix has changed to zero in the squared matrix. For those objectives which are still prerequisite but not immediately prerequisite, a number of equal to or greater than one will remain under the appropriate column. Both of these matrixes need not be retained, for example, on tape, disc, or computer memory, since they are redundant. If we scan the corresponding rows for the original matrix and the squared matrix, and identify those elements where ones change to zero, and replace the corresponding zero in the squared matrix with a minus one, all of the information has been contained in the squared matrix. The generation of dependencies for any particular student and for any particular terminal objective, would need only this altered squared matrix. We would need to return to the original matrix only if changes, deletions, or additions are made in the objective file. Numerous procedures are available for identifying recursive relationships accidently introduced into the system.

The following simple example, based on ten objectives, indicates how this might work. This could easily be expanded to a large number of instructional objectives (instructional modules) since the matrix squaring would appear only at the initial creations of the system or when changes must be made. The squaring of even large matrixes would proceed rapidly, with the proper mathematical algorithm, since only integer values of one and zero are involved.

FIGURE V

Sample of 10 Objectives



Matrix A

Column / Row	1	2	3	4	5	6	7	8	9	10
1	0	1	1	1	1	1	0	0	0	1
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	1	1	1	0	0	0	1
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	1
6	0	0	0	0	0	0	0	0	0	1
7	0	0	0	0	0	1	0	1	1	1
8	0	0	0	0	0	1	0	0	1	1
9	0	0	0	0	0	0	0	0	0	1
10	0	0	0	0	0	0	0	0	0	0

Matrix B

Column / Row	1	2	3	4	5	6	7	8	9	10
1	0	-1	-1	1	1	1	0	0	0	3
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	-1	-1	-1	0	0	0	2
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	-1
6	0	0	0	0	0	0	0	0	0	-1
7	0	0	0	0	0	1	0	-1	1	3
8	0	0	0	0	0	-1	0	0	-1	2
9	0	0	0	0	0	0	0	0	0	-1
10	0	0	0	0	0	0	0	0	0	0

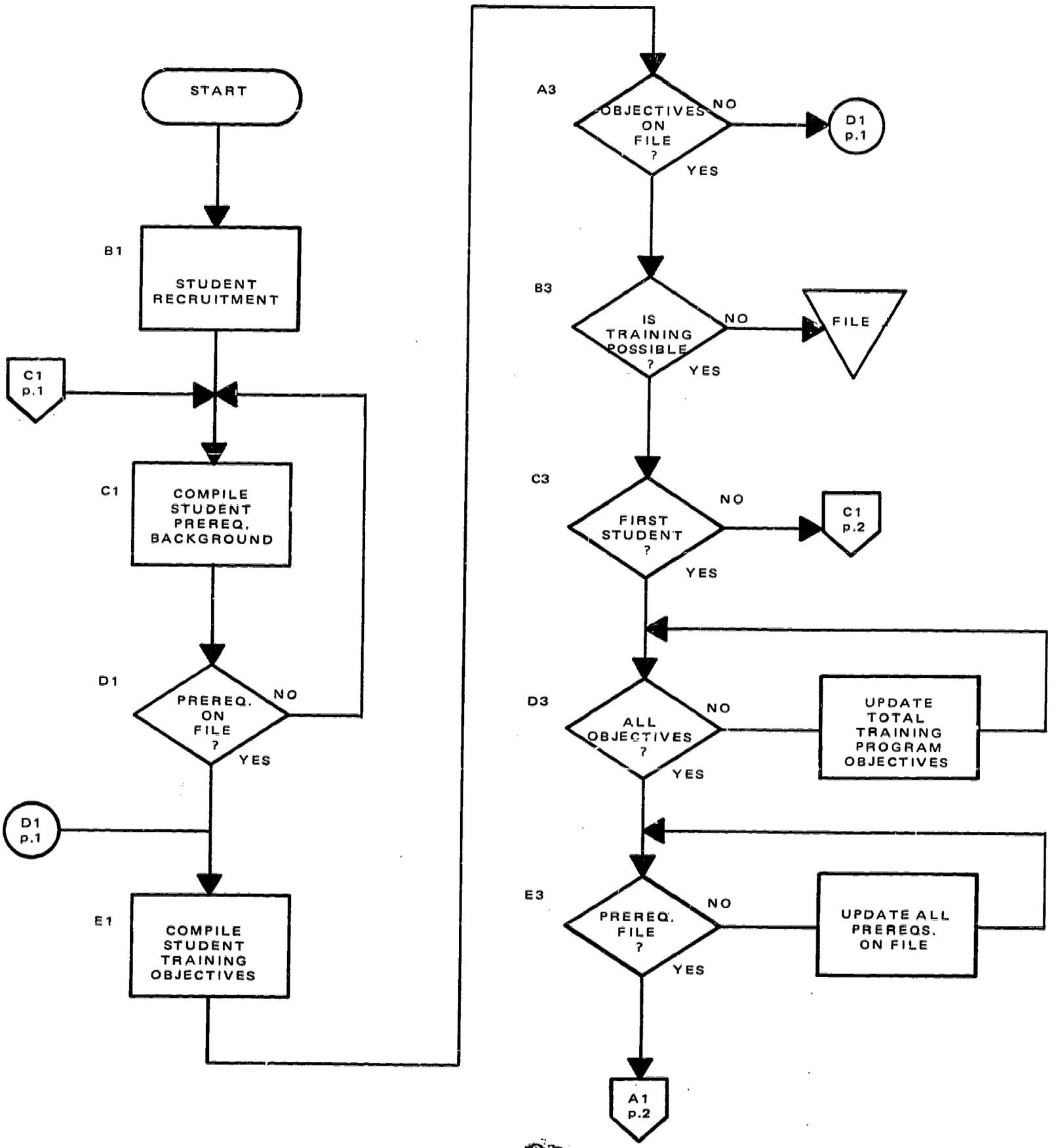
The PERT diagram represents the dependencies among our ten sample objectives. The student would proceed from right to left, objectives one and seven being the "most" terminal of the set of ten. This information would be stored in the original matrix, identified as Matrix A. If we look at the PERT diagram, we see that objectives 2, 3, 4, 5, 6, and 10 are all prerequisite for objective one. Therefore in row one of Matrix A, ones appear in column 2, 3, 4, 5, 6, and 10, with zeros in the other elements. Similarily, we notice that objectives 6, 9, and 10 are prerequisite for objective 8. Therefore in Matrix A, row 8, we find ones in column 6, 9, and 10, and zeros in the other columns. If we square Matrix A and substitute a minus one for those elements which change from one to zero, we have Matrix B. This matrix contains all of the information necessary for generating prerequisite "trees."

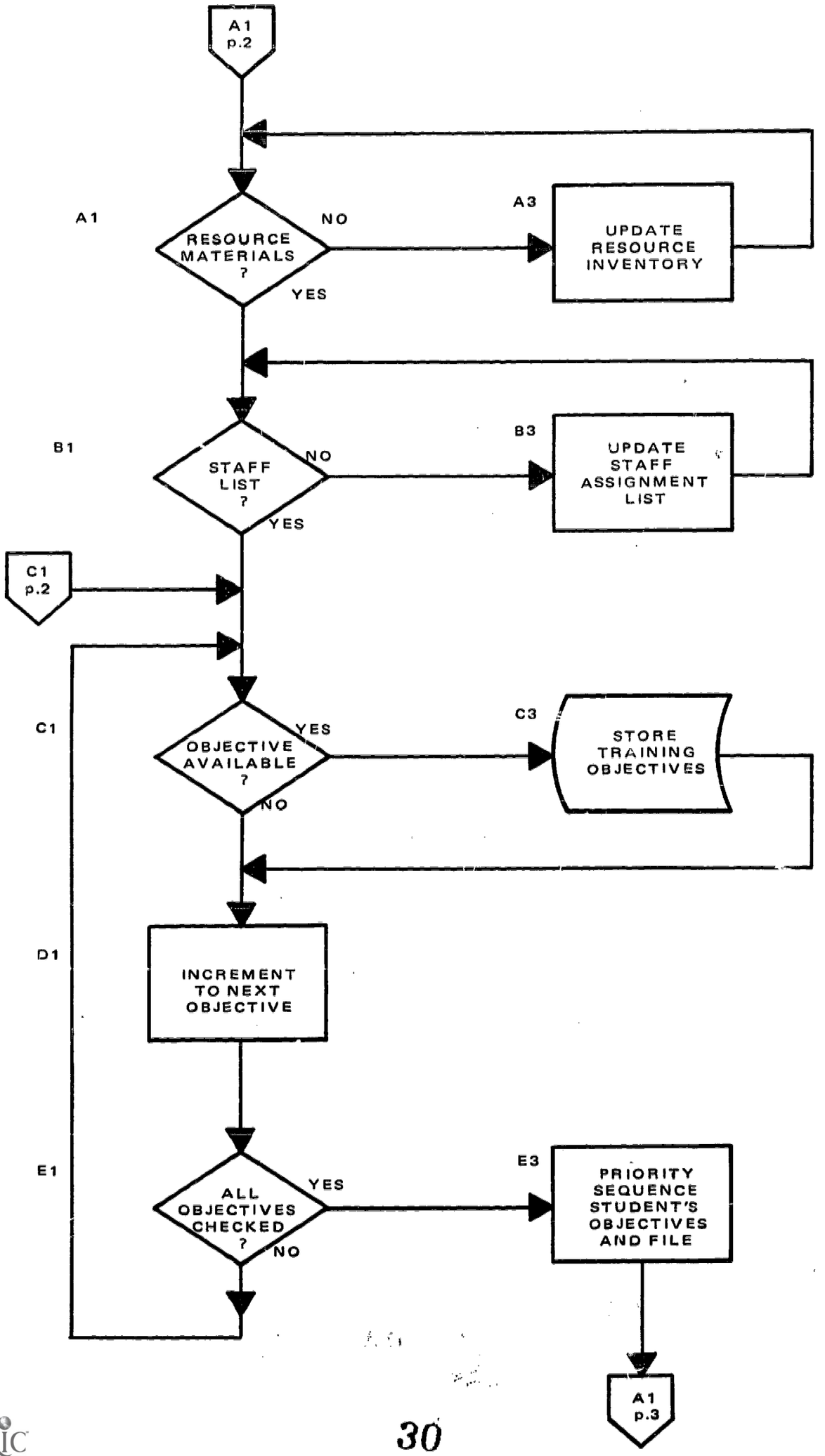
For example, suppose that objective one is selected as a terminal objective. If we scan across row one of Matrix B, we instantly see that objectives 2 and 3 are immediately prerequisite and that objectives 4, 5, and 10 are prerequisite, but at least one step removed. We would, therefore, scan across row 2 to see which objectives are prerequisite for it, and find that there are none, since all of the elements in that row are zero. Next, we scan across row 3, and find that objectives 4, 5, and 6 are immediately prerequisite for objective 3. Next, we would scan across row 4 and find that there are no immediately prerequisite objectives for objective 4. Next, we would scan across rows 5 and

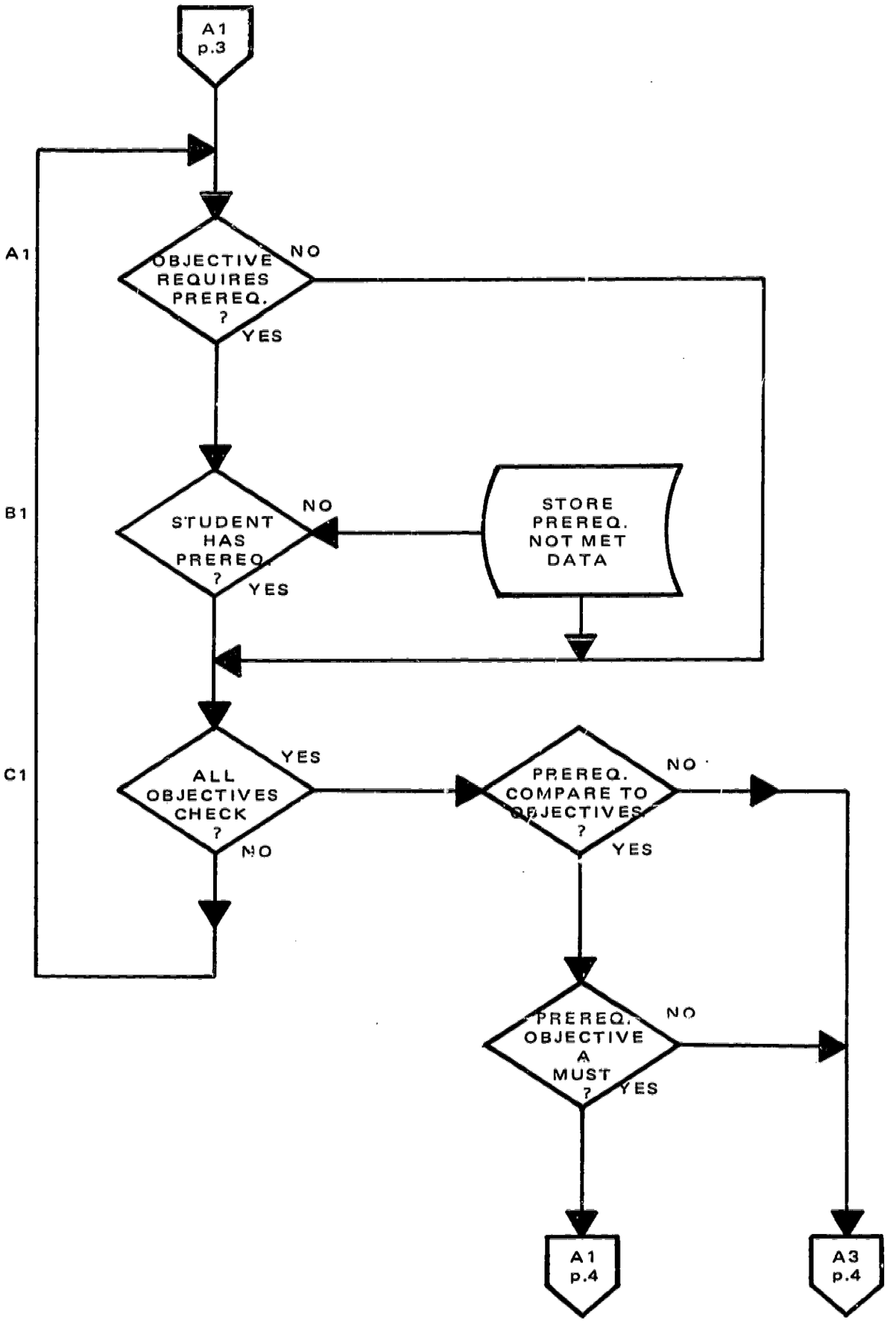
6, finding in both cases that 10 is an immediately prerequisite objective for both of these. It is obvious, of course, that any objectives may be specified as a terminal objective for a given trainee, not just the ones to the left most side of the dependency diagram.

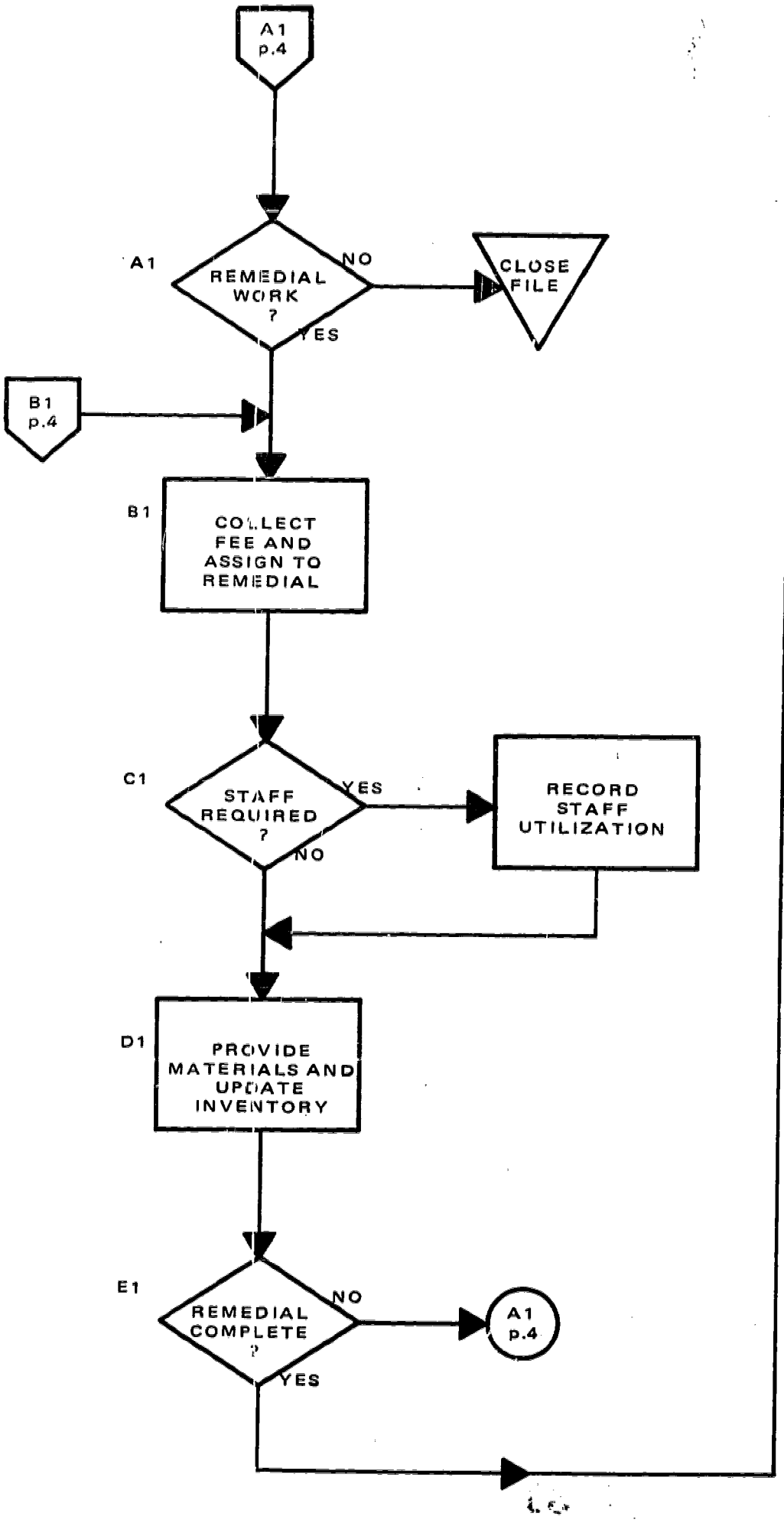
The instructional management system may be consulted to see how this would be applied to an actual student. Basically, a student would be tested or decisions otherwise made as to what point on the branches, moving from right to left, he should begin instruction, based on prerequisite skills and knowledges.

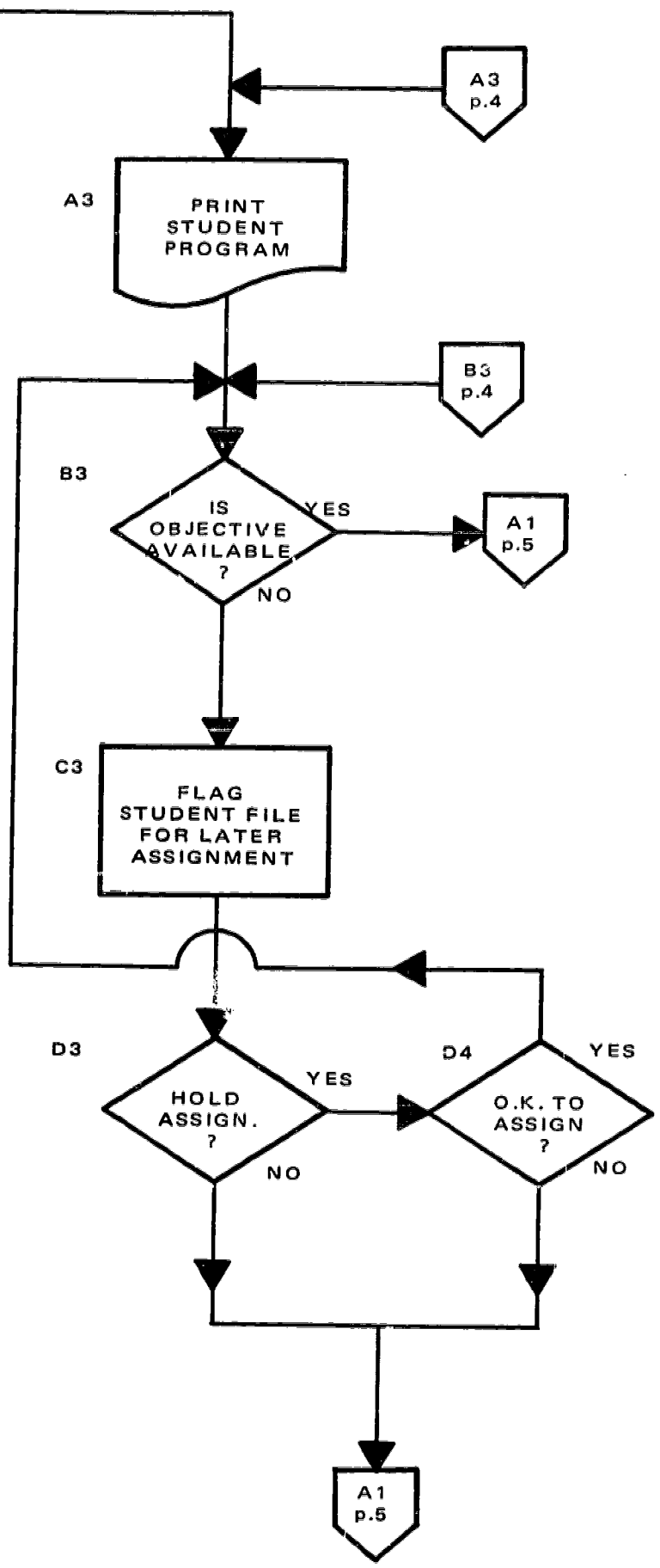
Part 4 - MANAGEMENT SYSTEM FLOW CHARTS

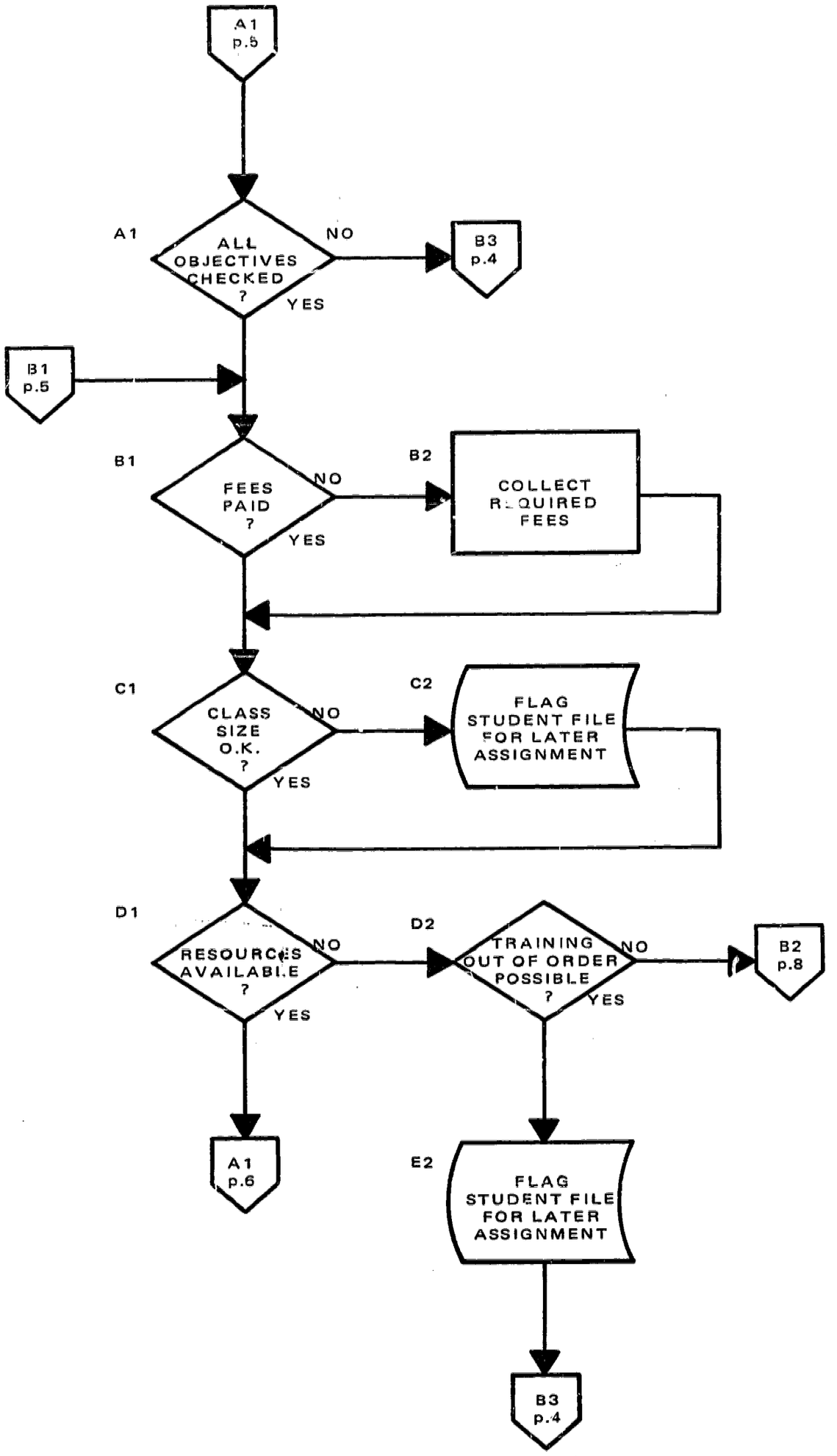


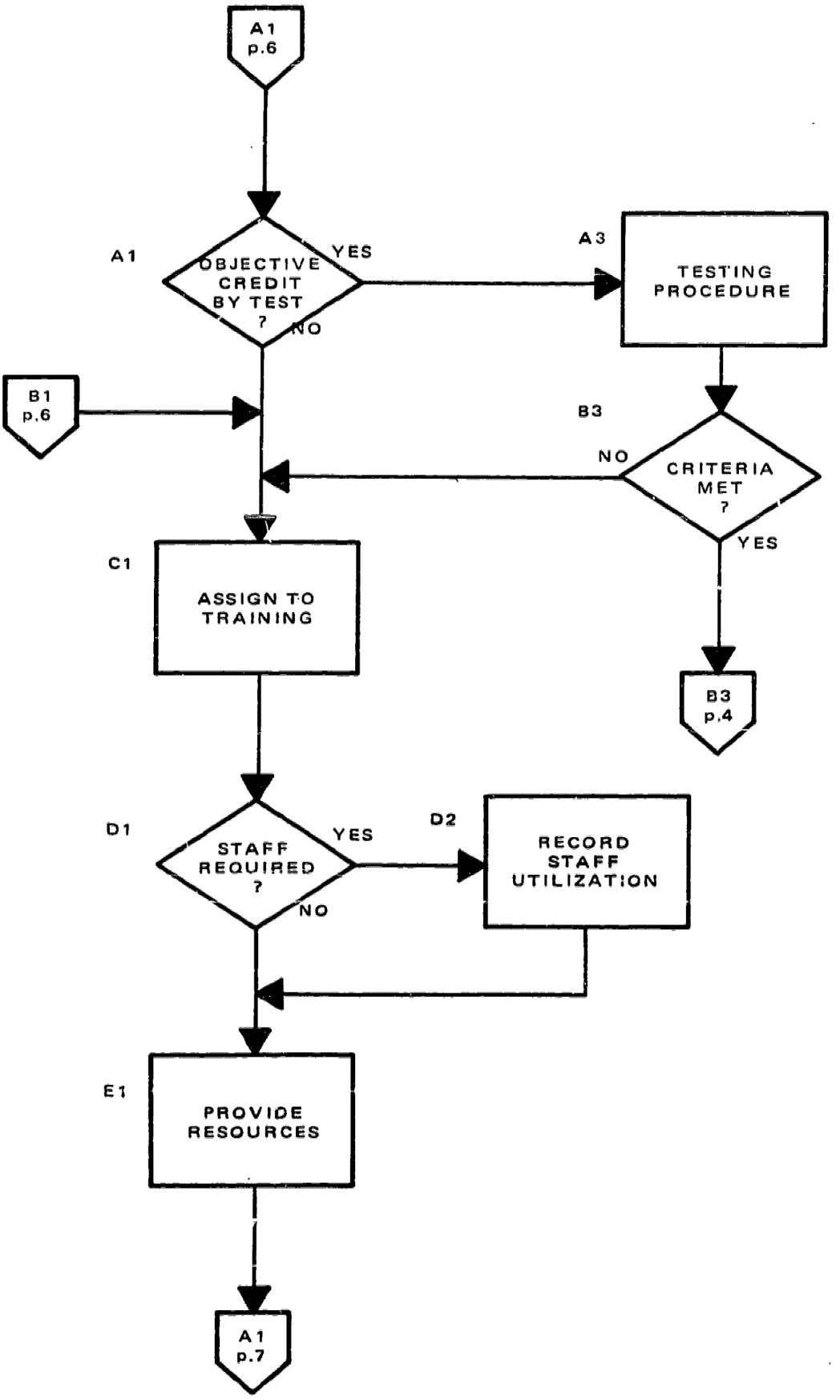

A1
p.2
A1
RESOURCE MATERIALS ?
NO
YES
A3
UPDATE RESOURCE INVENTORY
B1
STAFF LIST ?
NO
YES
B3
UPDATE STAFF ASSIGNMENT LIST
C1
p.2
C1
OBJECTIVE AVAILABLE ?
YES
NO
C3
STORE TRAINING OBJECTIVES
D1
INCREMENT TO NEXT OBJECTIVE
E1
ALL OBJECTIVES CHECKED ?
YES
NO
E3
PRIORITY SEQUENCE STUDENT'S OBJECTIVES AND FILE
A1
p.3

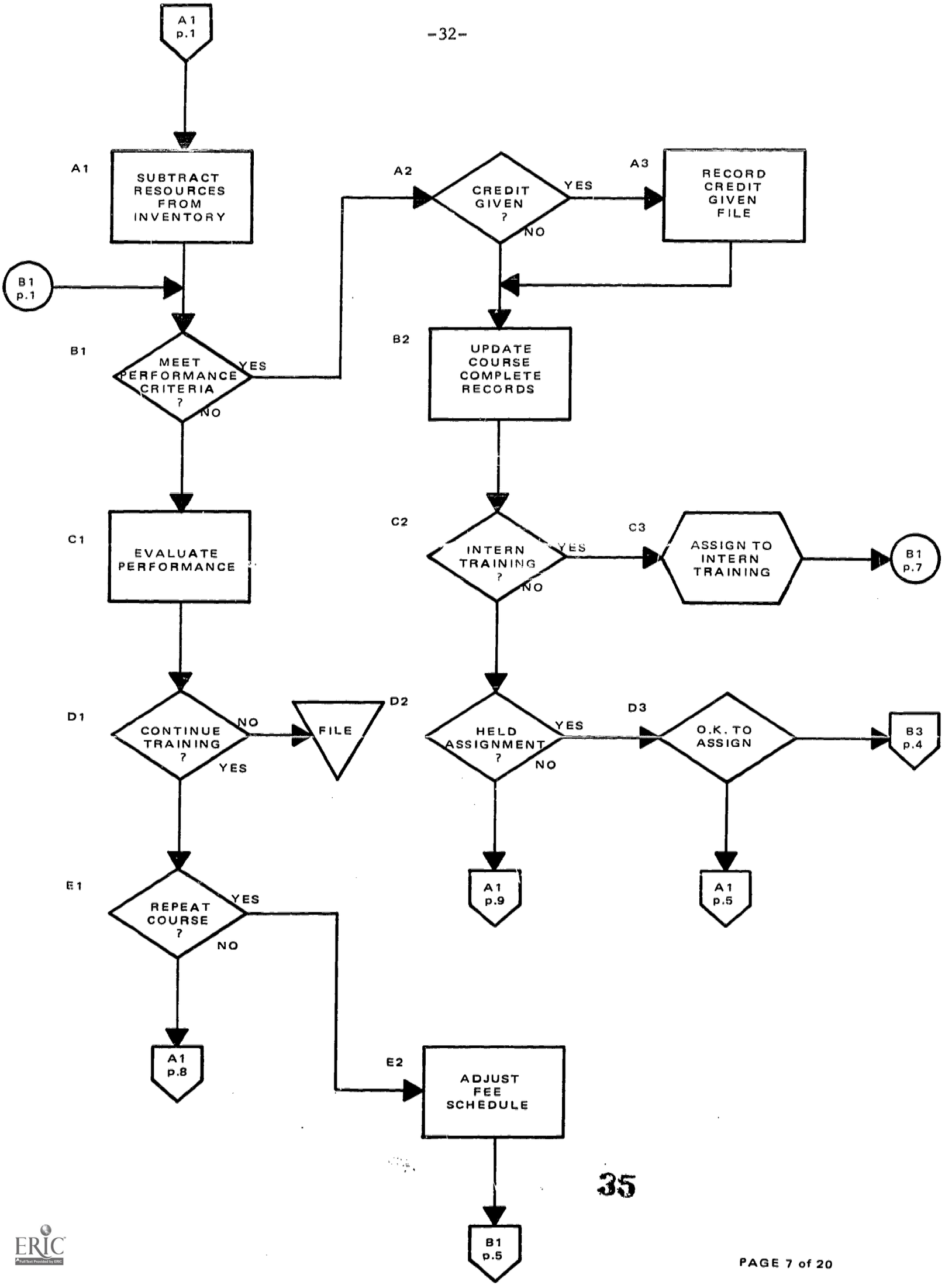

A1
p.3
A1
OBJECTIVE REQUIRES PREREQ. ?
NO
YES
B1
STUDENT HAS PREREQ. ?
NO
YES
STORE PREREQ. NOT MET DATA
C1
ALL OBJECTIVES CHECK ?
YES
NO
PREREQ. COMPARE TO OBJECTIVES ?
NO
YES
PREREQ. OBJECTIVE A MUST ?
NO
YES
A1
p.4
A3
p.4

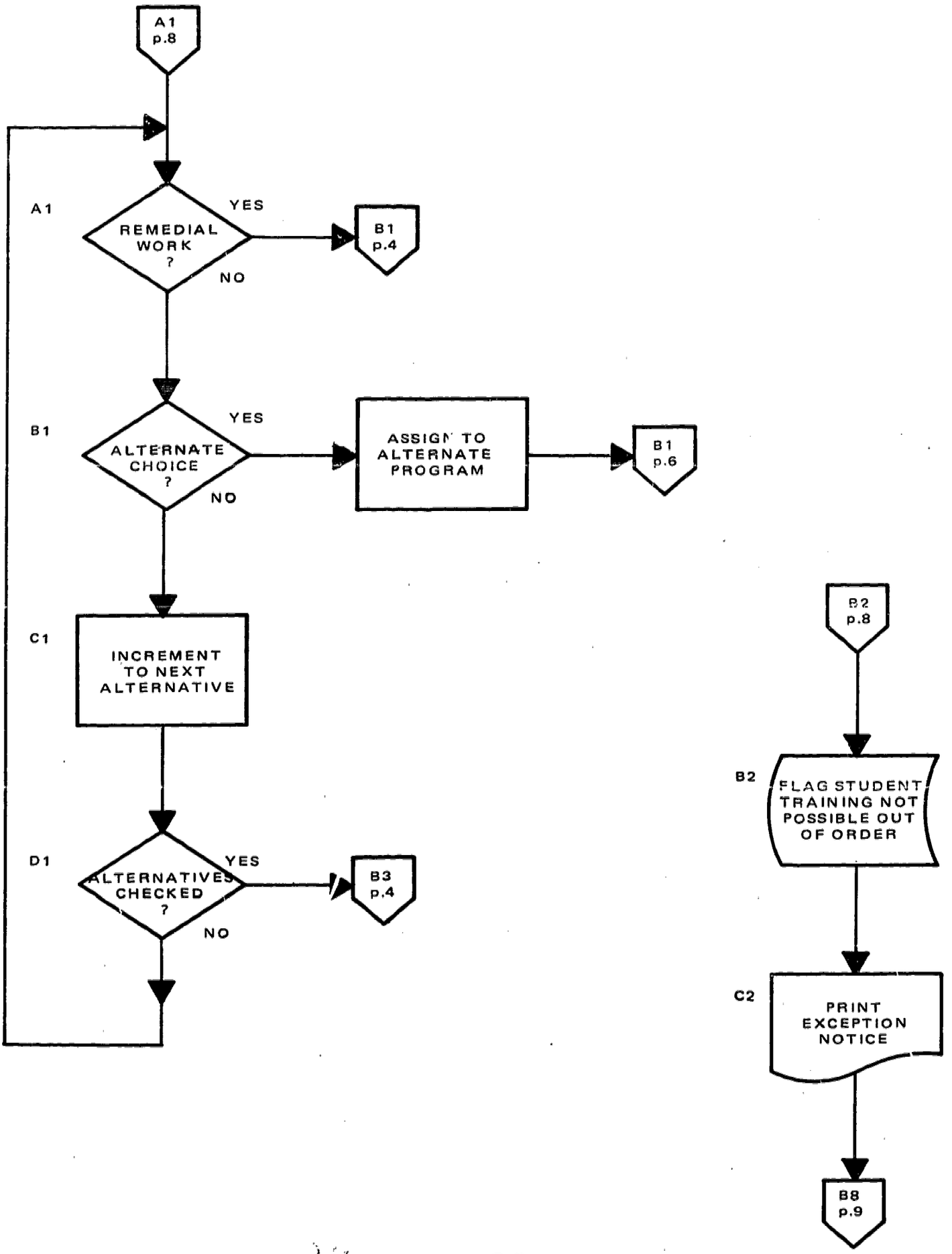

A1
p.4
A1
REMEDIAL
WORK
?
NO
YES
CLOSE
FILE
B1
p.4
B1
COLLECT
FEE AND
ASSIGN TO
REMEDIAL
C1
STAFF
REQUIRED
?
YES
NO
RECORD
STAFF
UTILIZATION
D1
PROVIDE
MATERIALS AND
UPDATE
INVENTORY
E1
REMEDIAL
COMPLETE
?
NO
YES
A1
p.4

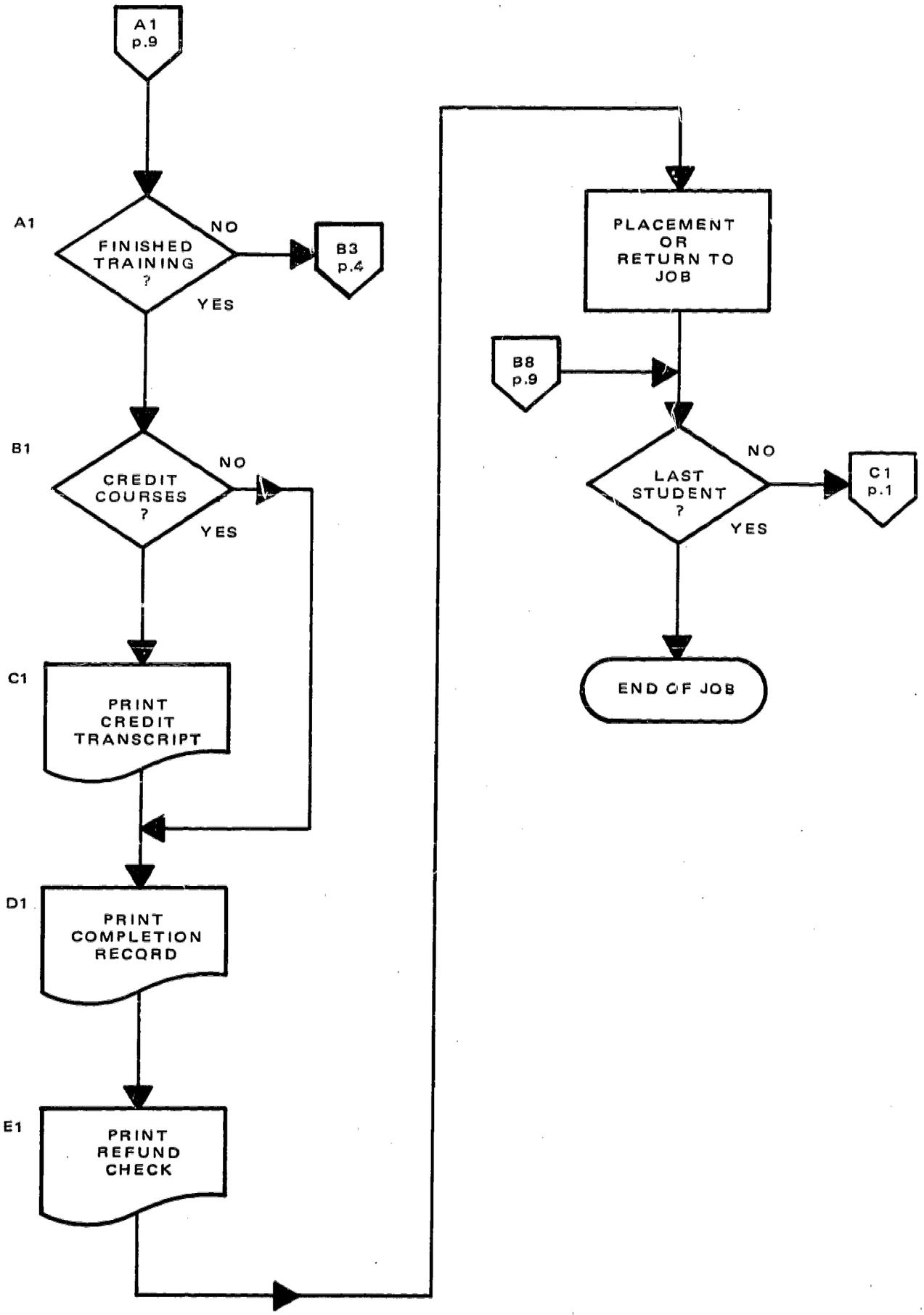

A3
p.4
A3
PRINT
STUDENT
PROGRAM
B3
p.4
B3
IS
OBJECTIVE
AVAILABLE
?
YES
NO
A1
p.5
C3
FLAG
STUDENT FILE
FOR LATER
ASSIGNMENT
D3
HOLD
ASSIGN.
?
YES
NO
D4
O.K. TO
ASSIGN
?
YES
NO
A1
p.5

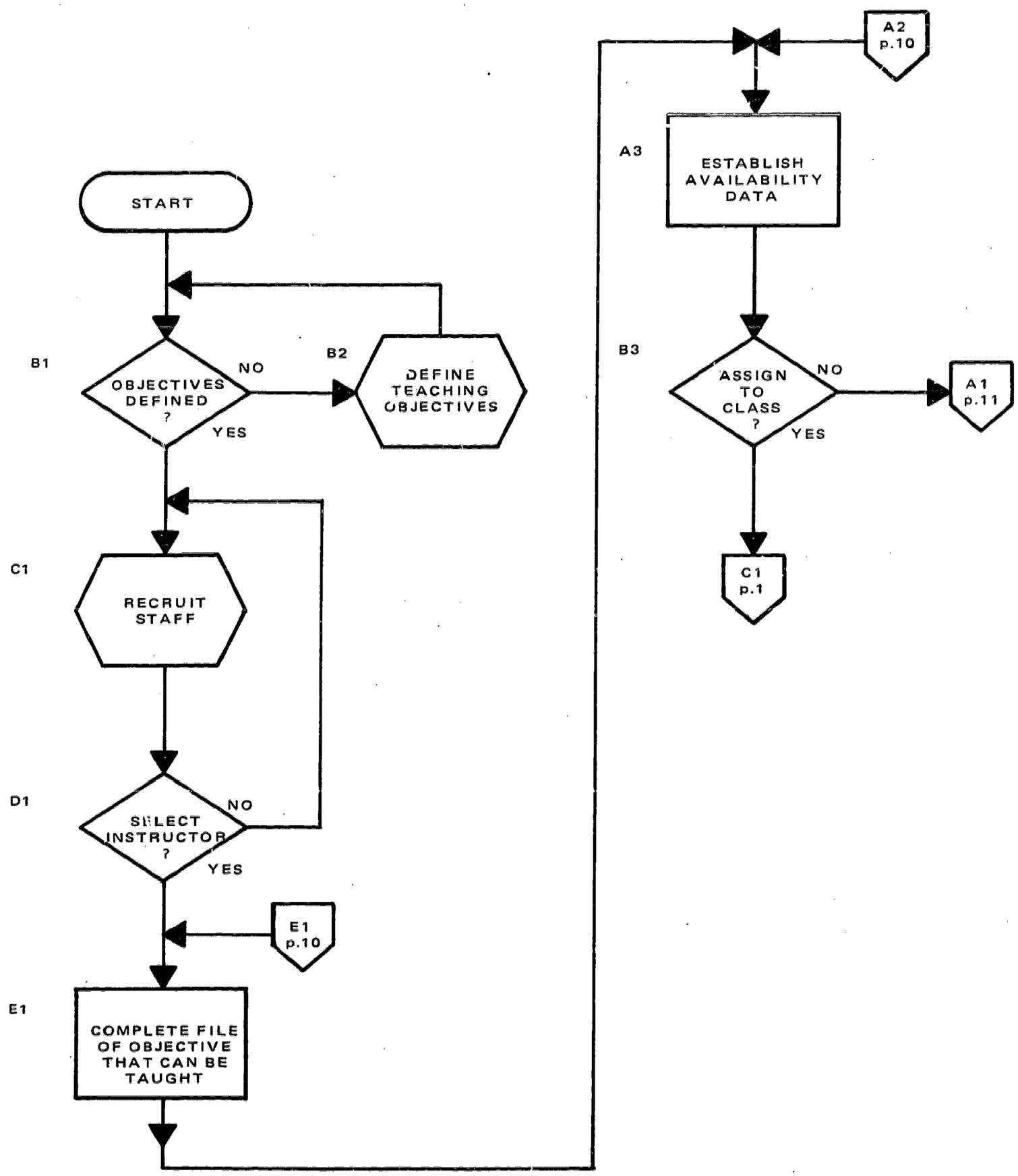

A1
p.5
A1
ALL OBJECTIVES CHECKED ?
NO
YES
B3
p.4
B1
p.5
B1
FEES PAID ?
NO
YES
B2
COLLECT REQUIRED FEES
C1
CLASS SIZE O.K. ?
NO
YES
C2
FLAG STUDENT FILE FOR LATER ASSIGNMENT
D1
RESOURCES AVAILABLE ?
NO
YES
D2
TRAINING OUT OF ORDER POSSIBLE ?
NO
YES
B2
p.8
A1
p.6
E2
FLAG STUDENT FILE FOR LATER ASSIGNMENT
B3
p.4

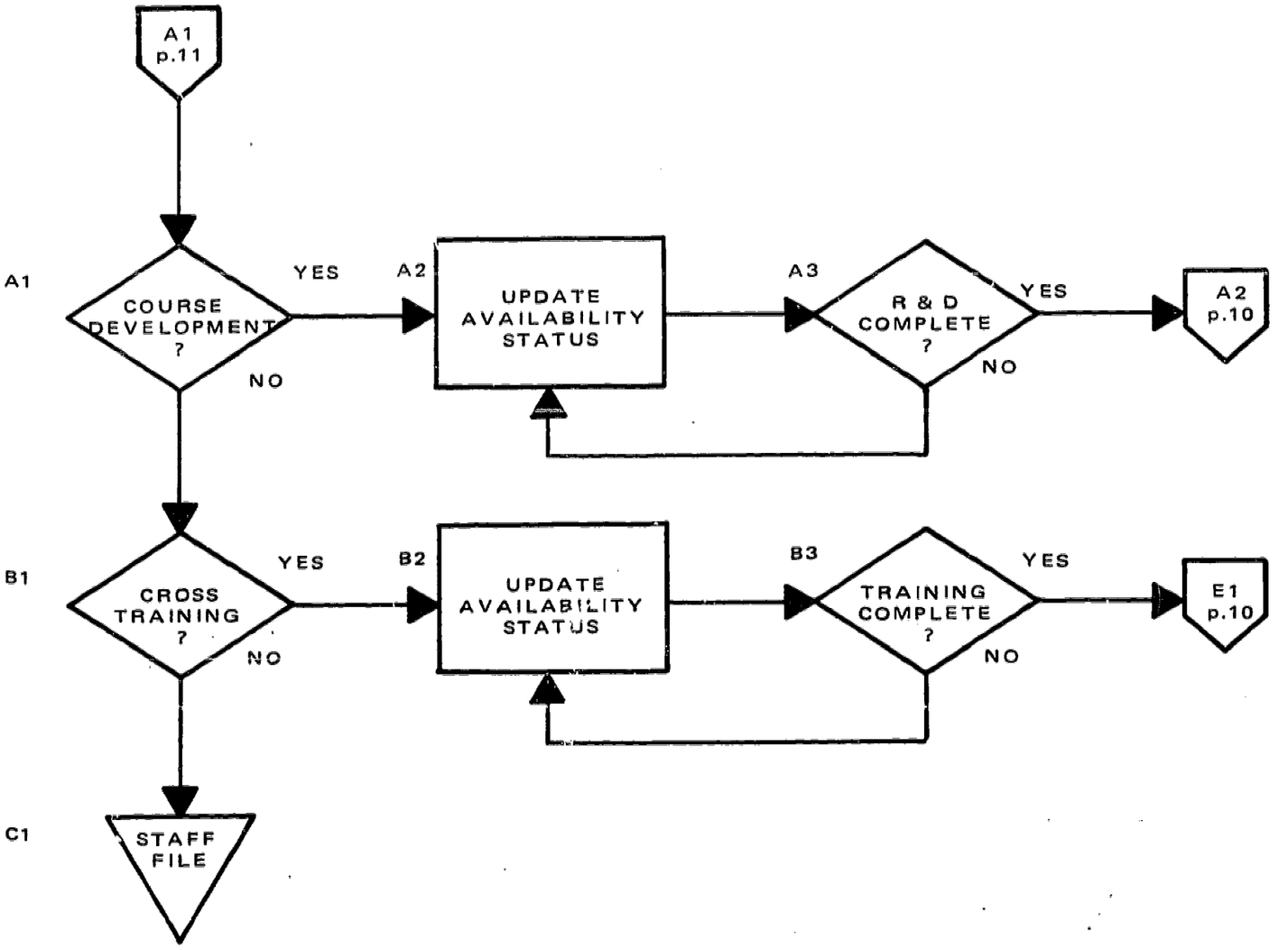

A1
p.6
A1
OBJECTIVE CREDIT BY TEST ?
YES
NO
A3
TESTING PROCEDURE
B1
p.6
B3
CRITERIA MET ?
NO
YES
C1
ASSIGN TO TRAINING
B3
p.4
D1
STAFF REQUIRED ?
YES
NO
D2
RECORD STAFF UTILIZATION
E1
PROVIDE RESOURCES
A1
p.7

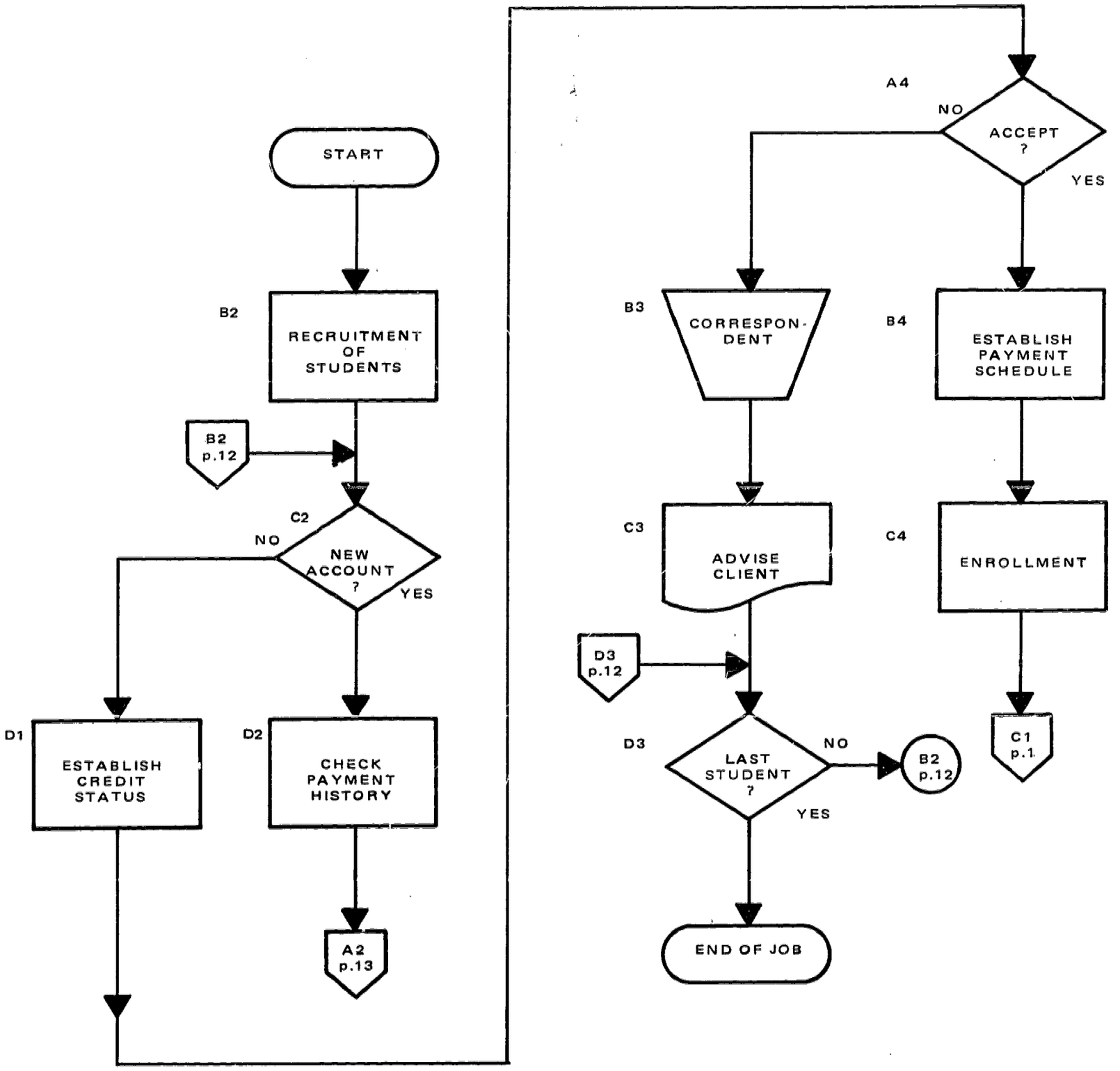

A1 p.1
A1
SUBTRACT RESOURCES FROM INVENTORY
B1 p.1
B1
MEET PERFORMANCE CRITERIA ?
YES
NO
A2
CREDIT GIVEN ?
YES
NO
A3
RECORD CREDIT GIVEN FILE
B2
UPDATE COURSE COMPLETE RECORDS
C1
EVALUATE PERFORMANCE
C2
INTERN TRAINING ?
YES
NO
C3
ASSIGN TO INTERN TRAINING
B1 p.7
D1
CONTINUE TRAINING ?
NO
YES
FILE
D2
HELD ASSIGNMENT ?
YES
NO
D3
O.K. TO ASSIGN
B3 p.4
E1
REPEAT COURSE ?
YES
NO
A1 p.9
A1 p.5
A1 p.8
E2
ADJUST FEE SCHEDULE
B1 p.5

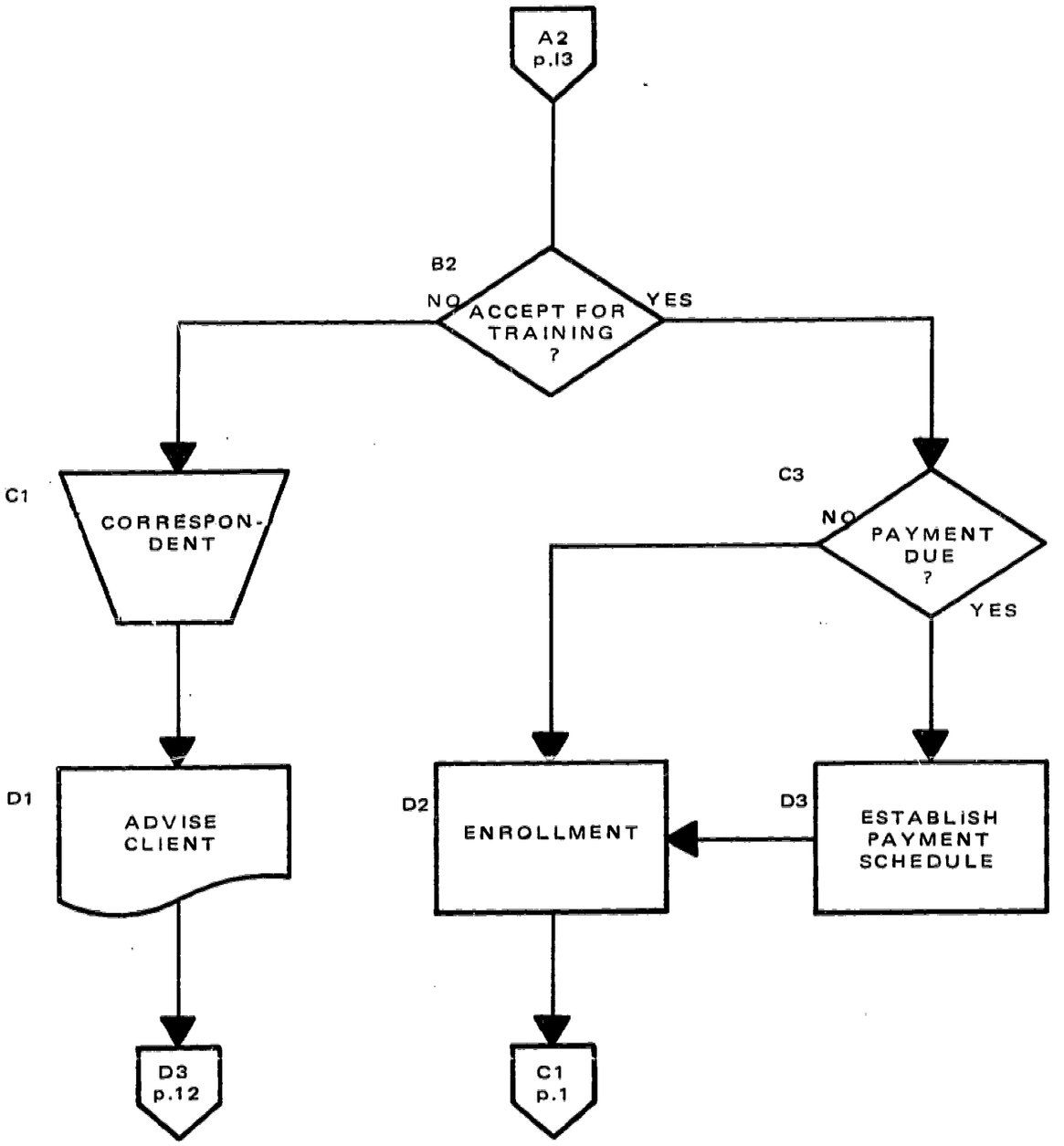

A1
p.8
A1
REMEDIAL WORK ?
YES
NO
B1
p.4
B1
ALTERNATE CHOICE ?
YES
NO
ASSIGN TO ALTERNATE PROGRAM
B1
p.6
C1
INCREMENT TO NEXT ALTERNATIVE
D1
ALTERNATIVES CHECKED ?
YES
NO
B3
p.4
B2
p.8
B2
FLAG STUDENT TRAINING NOT POSSIBLE OUT OF ORDER
C2
PRINT EXCEPTION NOTICE
B8
p.9

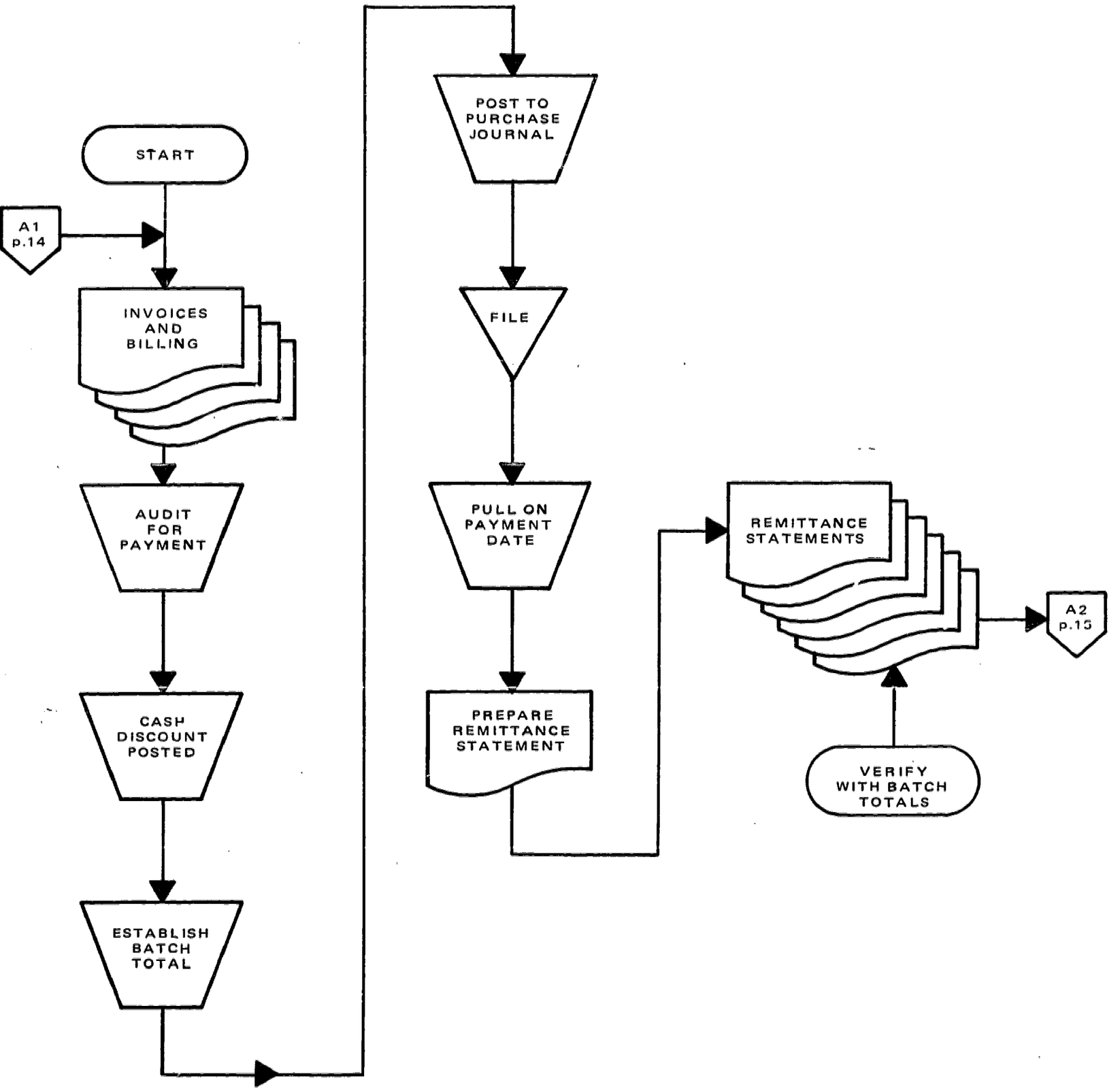

A1
p.9
A1
FINISHED TRAINING ?
NO
YES
B3
p.4
B1
CREDIT COURSES ?
NO
YES
C1
PRINT CREDIT TRANSCRIPT
D1
PRINT COMPLETION RECORD
E1
PRINT REFUND CHECK
PLACEMENT OR RETURN TO JOB
B8
p.9
LAST STUDENT ?
NO
YES
C1
p.1
END OF JOB

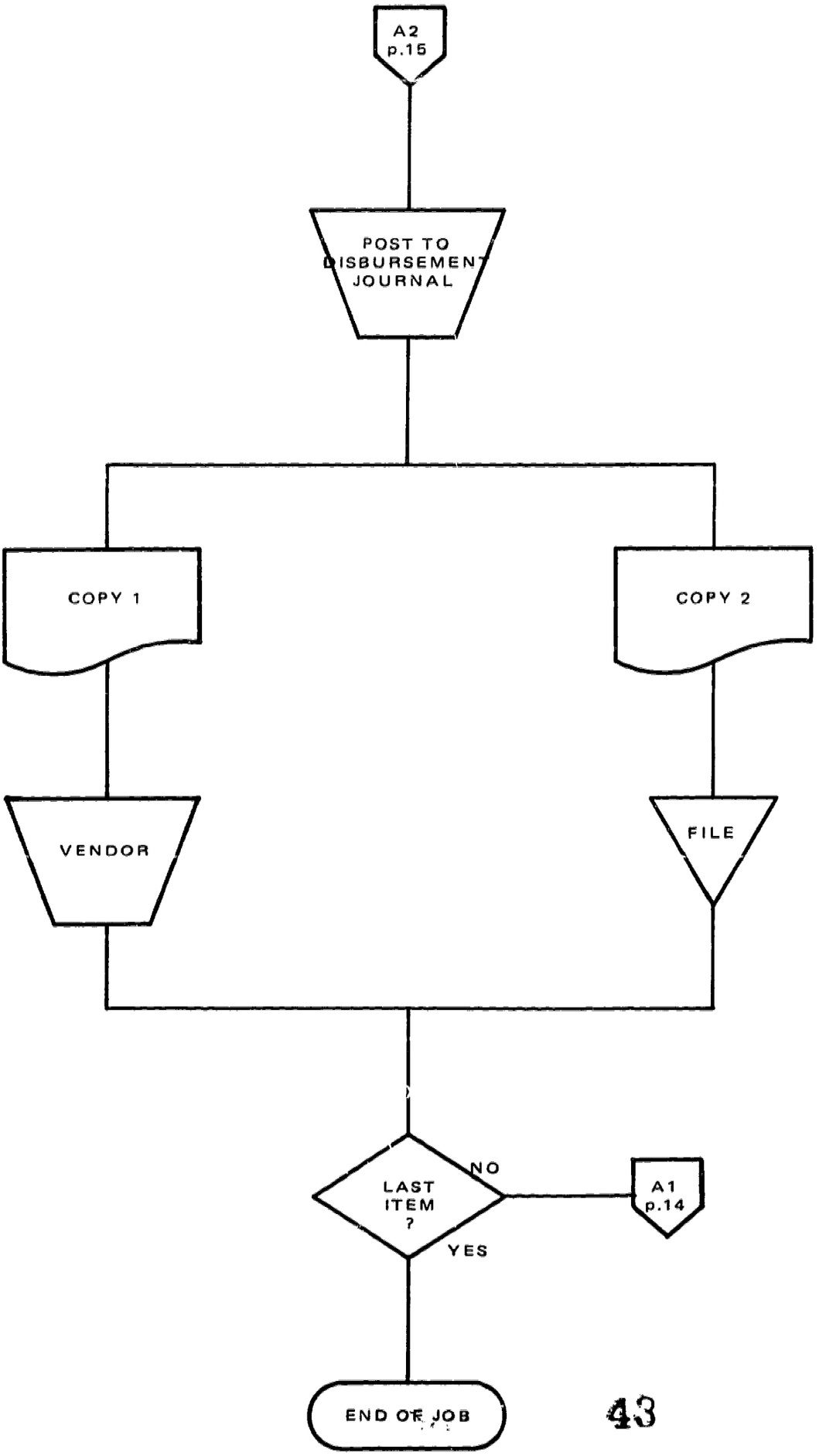

START
B1
OBJECTIVES DEFINED ?
NO
YES
B2
DEFINE TEACHING OBJECTIVES
C1
RECRUIT STAFF
D1
SELECT INSTRUCTOR ?
NO
YES
E1 p.10
E1
COMPLETE FILE OF OBJECTIVE THAT CAN BE TAUGHT
A2 p.10
A3
ESTABLISH AVAILABILITY DATA
B3
ASSIGN TO CLASS ?
NO
YES
A1 p.11
C1 p.1

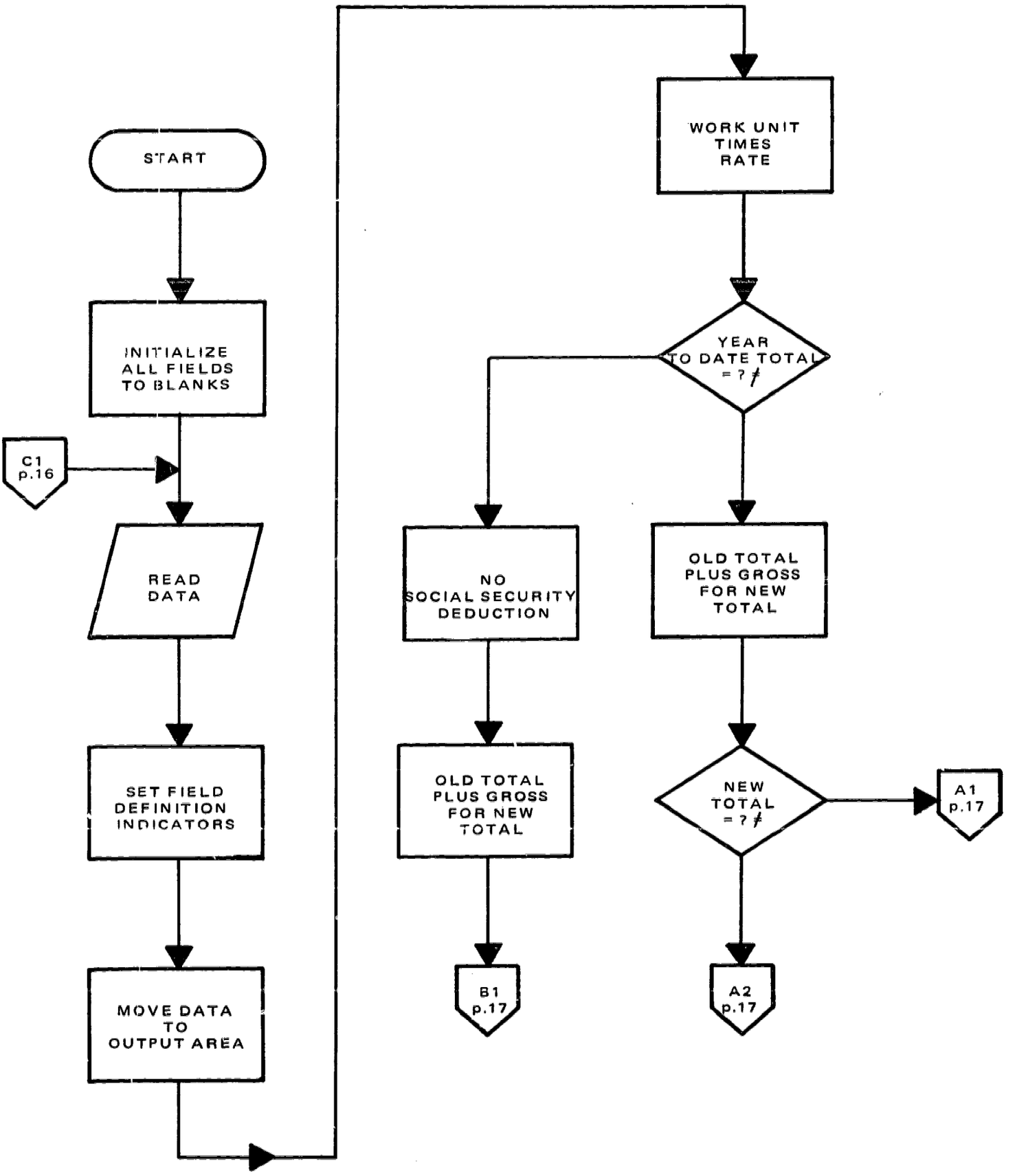

A1
p.11
A1
COURSE DEVELOPMENT ?
YES
NO
A2
UPDATE AVAILABILITY STATUS
A3
R & D COMPLETE ?
YES
NO
A2
p.10
B1
CROSS TRAINING ?
YES
NO
B2
UPDATE AVAILABILITY STATUS
B3
TRAINING COMPLETE ?
YES
NO
E1
p.10
C1
STAFF FILE

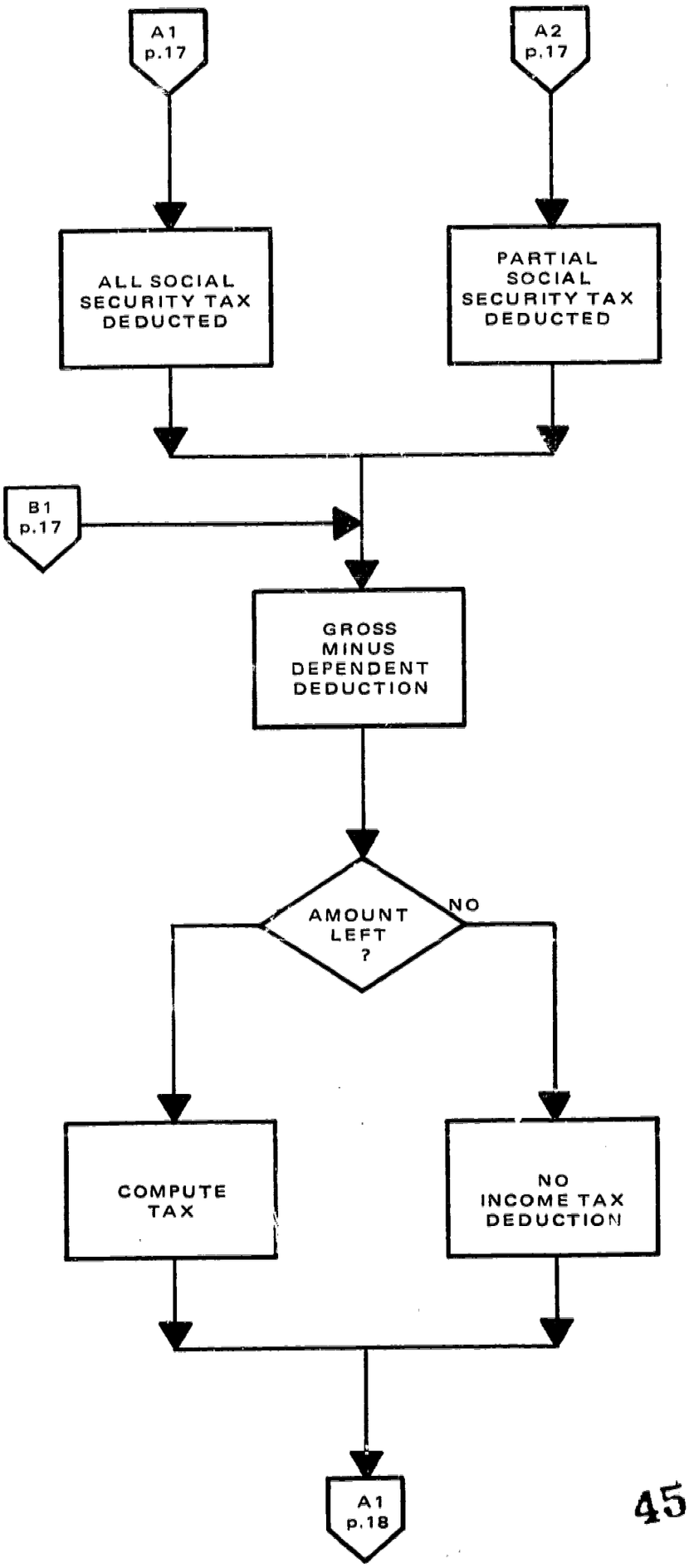

START
B2
RECRUITMENT OF STUDENTS
B2 p.12
C2
NO
NEW ACCOUNT ?
YES
D1
ESTABLISH CREDIT STATUS
D2
CHECK PAYMENT HISTORY
A2 p.13
A4
NO
ACCEPT ?
YES
B3
CORRESPON-DENT
B4
ESTABLISH PAYMENT SCHEDULE
C3
ADVISE CLIENT
C4
ENROLLMENT
D3 p.12
D3
LAST STUDENT ?
NO
B2 p.12
YES
C1 p.1
END OF JOB

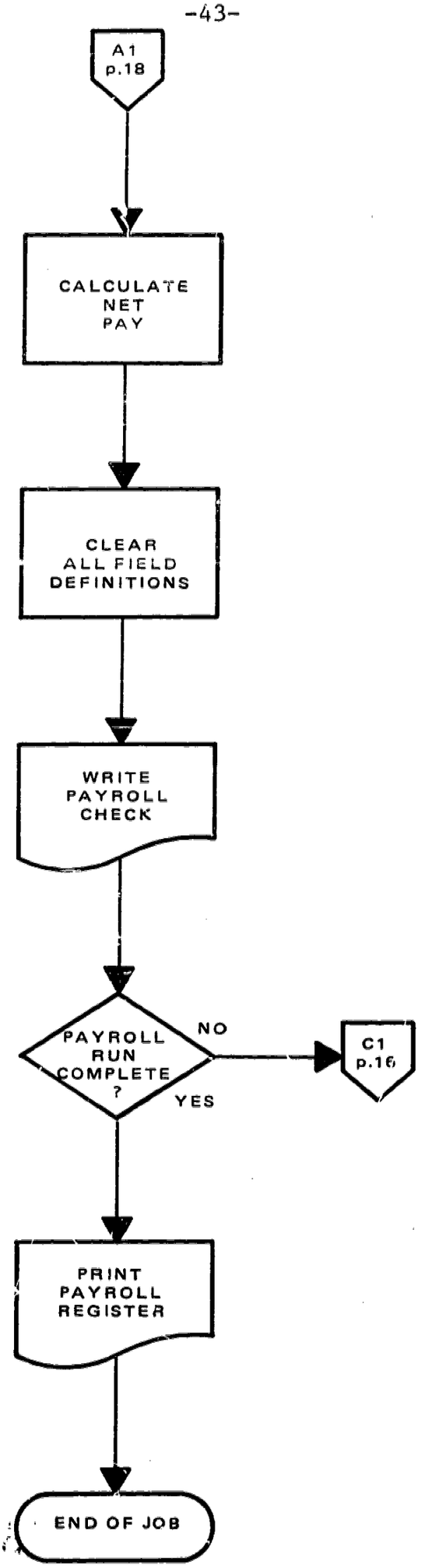

A2
p.13
B2
NO
ACCEPT FOR TRAINING ?
YES
C1
CORRESPON-DENT
C3
NO
PAYMENT DUE ?
YES
D1
ADVISE CLIENT
D2
ENROLLMENT
D3
ESTABLISH PAYMENT SCHEDULE
D3
p.12
C1
p.1

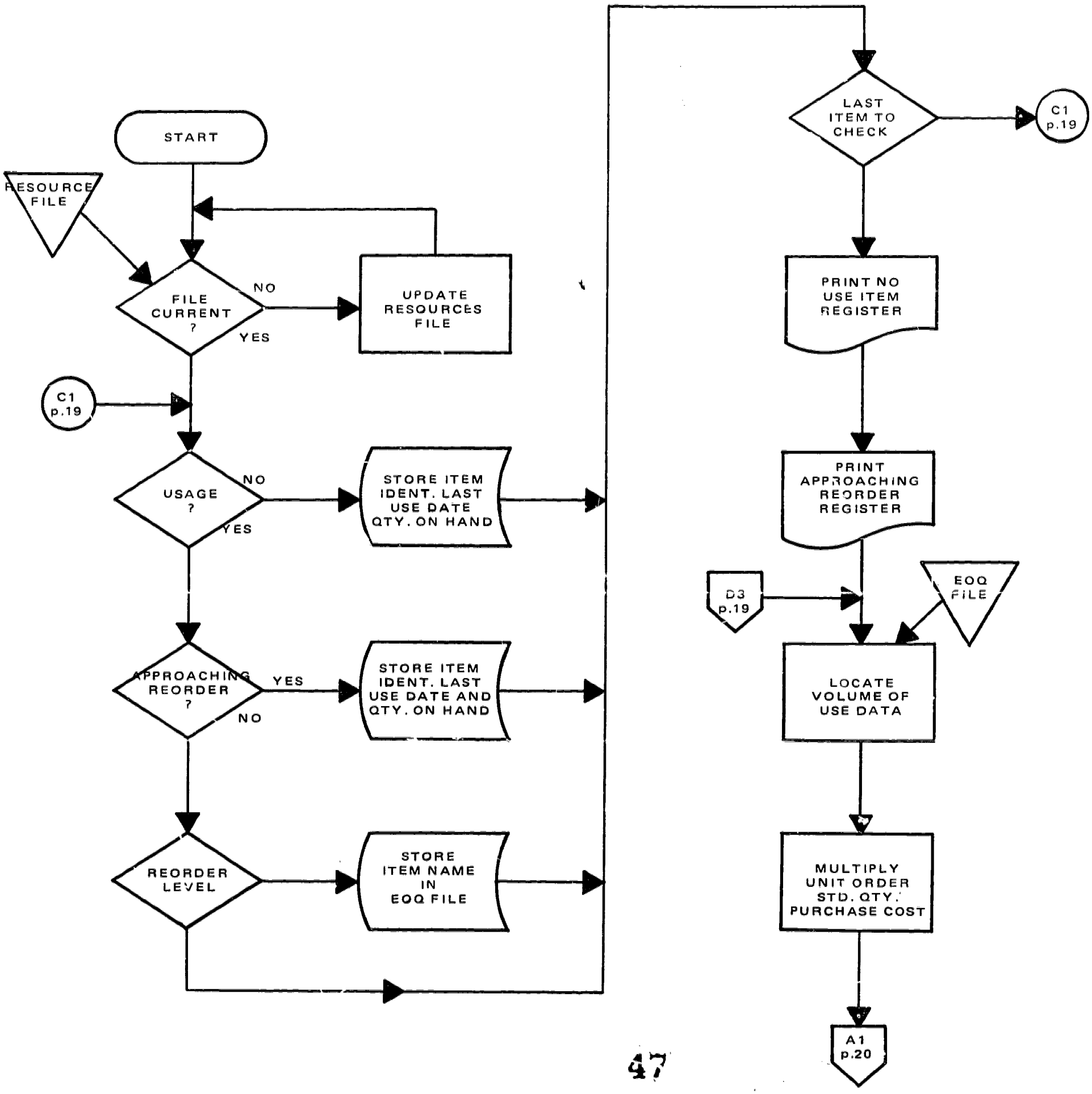

START
A1
p.14
INVOICES
AND
BILLING
AUDIT
FOR
PAYMENT
CASH
DISCOUNT
POSTED
ESTABLISH
BATCH
TOTAL
POST TO
PURCHASE
JOURNAL
FILE
PULL ON
PAYMENT
DATE
PREPARE
REMITTANCE
STATEMENT
REMITTANCE
STATEMENTS
A2
p.15
VERIFY
WITH BATCH
TOTALS

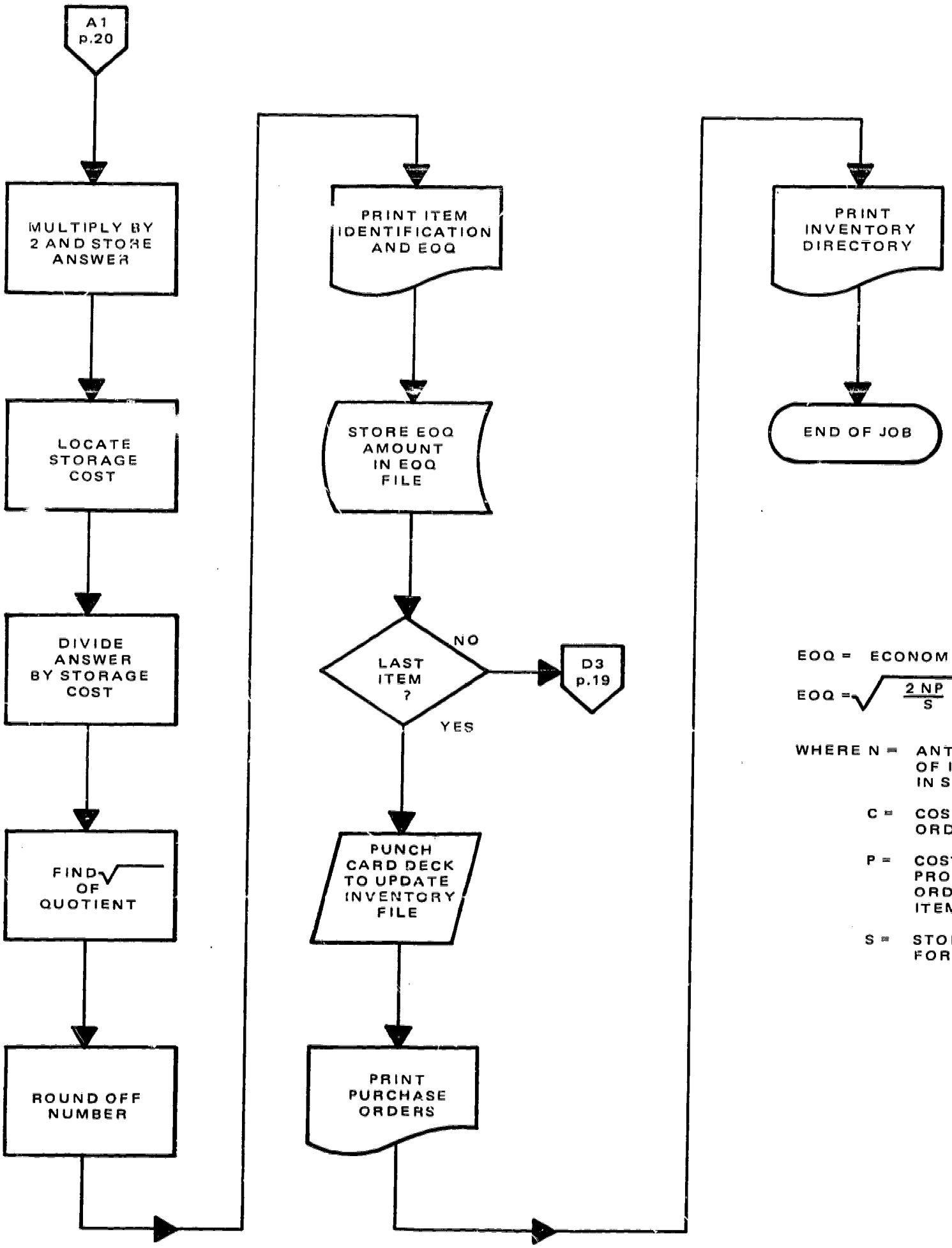

A2
p.15
POST TO
DISBURSEMENT
JOURNAL
COPY 1
COPY 2
VENDOR
FILE
LAST
ITEM
?
NO
YES
A1
p.14
END OF JOB


START
INITIALIZE ALL FIELDS TO BLANKS
C1 p.16
READ DATA
SET FIELD DEFINITION INDICATORS
MOVE DATA TO OUTPUT AREA
WORK UNIT TIMES RATE
YEAR TO DATE TOTAL = ? ≠
NO SOCIAL SECURITY DEDUCTION
OLD TOTAL PLUS GROSS FOR NEW TOTAL
B1 p.17
OLD TOTAL PLUS GROSS FOR NEW TOTAL
NEW TOTAL = ? ≠
A1 p.17
A2 p.17


A1
p.17
A2
p.17
ALL SOCIAL SECURITY TAX DEDUCTED
PARTIAL SOCIAL SECURITY TAX DEDUCTED
B1
p.17
GROSS MINUS DEPENDENT DEDUCTION
AMOUNT LEFT ?
NO
COMPUTE TAX
NO INCOME TAX DEDUCTION
A1
p.18


A1
p.18
CALCULATE
NET
PAY
CLEAR
ALL FIELD
DEFINITIONS
WRITE
PAYROLL
CHECK
PAYROLL
RUN
COMPLETE
?
NO
YES
C1
p.16
PRINT
PAYROLL
REGISTER
END OF JOB


START
RESOURCE FILE
FILE CURRENT ?
NO
YES
UPDATE RESOURCES FILE
C1 p.19
USAGE ?
NO
YES
STORE ITEM IDENT. LAST USE DATE QTY. ON HAND
APPROACHING REORDER ?
YES
NO
STORE ITEM IDENT. LAST USE DATE AND QTY. ON HAND
REORDER LEVEL
STORE ITEM NAME IN EOQ FILE
LAST ITEM TO CHECK
C1 p.19
PRINT NO USE ITEM REGISTER
PRINT APPROACHING REORDER REGISTER
D3 p.19
EOQ FILE
LOCATE VOLUME OF USE DATA
MULTIPLY UNIT ORDER STD. QTY. PURCHASE COST
A1 p.20



EOQ = ECONOMIC ORDER QUANTITY

$$EOQ = \sqrt{\frac{2NP}{S}}$$

WHERE N = ANTICIPATED NUMBER OF ITEMS TO BE USED IN SOME TIME UNIT

C = COST PER ITEM OR UNIT ORDER

P = COST OF PREPARING AND PROCESSING A PURCHASE ORDER FOR ONE LOT OF ITEM

S = STORAGE COST FOR ITEM FOR ONE MONTH

Part 5 - FLOW CHART DOCUMENTATION *

The pages which follow provide explanation and support for the significant features of the program flow charts. Each page describes a single flow chart symbol according to the format below.

Symbol Title (refers directly to the notation found in the symbol) (symbol coordinates)

Program Function

Those symbols chosen for description are in some way essential to the operation of the program. Their special features are noted here as are important interactions between this program element and others.

Information Utilization

The type of information employed in carrying out the function described above is discussed. Special note is made of operations which are to be performed with/on information.

Information Source

If a form or process exists whereby information can be gathered to carry out the program function, it is noted here. Where special forms or procedures must be developed in order to gather such information, an appropriate indication is made.

* Page numbers noted in Part 5 content refer to the page numbers on lower right hand corners of flow chart (Part 4) and not to the continuous numbering of the document pages.

STUDENT RECRUITMENT
(B1, p. 1)

Program Function

Provides basic demand for program output. Combination of recruitment outcome plus requests for organizational diagnosis (E1, p. 1) results in measure of program priorities for development and implementation. Basic control over recruitment is lodged in the content of training available. That is, persons are recruited only for training currently available - inquiries for training which cannot be given are stored for possible future program development. (B3, p. 1)

Information Utilization

Basic datum in projected demand for program objectives (training programs). Demand as function of time is needed as is indication of the locus of demand, e.g., organization, student, etc..

Information Source

A standard inquiry/response form is needed to obtain information. This form must be designed to facilitate coding of information for various program files. Data collected via this form should include demographic information on clients and organizations, actual and anticipated roles as well as direct keying to the classification system of the Program Objectives File.

COMPILE STUDENT PREREQUISITE BACKGROUND
(C1, p. 1)

Program Function

Insures entry level skills for program clients. Each program path (see discussion of Program Objectives File) has basic skills which are prerequisite to training objectives in that path. The accumulated prerequisite data across all clients identifies deficiencies which may require development of new training programs.

Information Utilization

Students proceed through instruction if they have prerequisites for their chosen program path (see Diagnosis, E1, p. 1). New training packages are developed for deficiencies exhibited for large numbers of students.

Information Source

A program based on careful definition of skills cannot rely on certification of prerequisite skills by other organizations. Thus, transcripts and other certification of training completion plus many normative tests become unacceptable data sources. Special demonstration tests or exercises must be developed for sampling whole patterns of prerequisite skills. Special intensive tests may follow as related to program path of client (E1, p. 1).

COMPILE STUDENT TRAINING OBJECTIVES
(E1, p. 1)

Program Function

Establishes the clusters of skills desired by an organization and/or the program path (see Program Objectives File) to be followed by the student. This is essentially a diagnostic routine whereby roles are synthesized for students or role training desired by an organization is analyzed into skills. The completion of objectives is not to preclude the design (or redesign) of jobs within organizations.

Information Utilization

The list of student objectives resulting from the diagnostic operation is to be coded to the Program Objectives File. Initial matching of objectives stated by student or organization may be carried out by a content based search routine such as the IBM Key Word in Context procedure (IBM, 1962). Coded student objectives are then matched to the Program Objectives File to determine whether student can be trained (B3, p. 1), (B3 p. 4). The objectives resulting from diagnostic services to organizations can be aggregated into new roles (see Program Objectives File) and demand for new training objectives used to key training materials development.

Information Source

Two diagnostic routines must be developed:

a) student diagnosis: using role desired as point of entry to diagnosis, specific desired training objectives and program paths can be derived.

b) organizational diagnosis: skills desired by organizations become the basis for systhesizing program paths and/or defining new jobs within the organization.

A search procedure must be developed to translate objectives of students and organizations into the classification system of the Program Objectives File.

RESOURCE MATERIALS
(A1, p. 2)

Program Function

The use of many forms of instructional materials and assists demands continuous, in the sense of "on-line", information as to materials availability. These materials derive their importance from their role in instruction - which is to cause the desired student response to occur.

Information Utilization

The signal that resources are available activates subsequent steps in the provision of a given objective to a student. This same information is used again (D1, p. 5) for a second control on entry to instruction. The Resource Inventory (A1, p. 7) is kept current for instruction control as well as for the purpose of materials re-order (pp. 19-20).

Information Source

Source is the Resource Inventory (A1, p. 2). This is keyed to objectives and is kept current by a form of inventory control probably analogous to that used in scientific supply stockrooms (Jenevein, et. al., 1968).

STAFF LIST
(B1, p. 2)

Program Function

Provides inventory of human resources available for instruction, materials and program production, program research and development and diagnostic services.

Information Utilization

Staff skill and availability constitute prior holds on student assignment to objectives. Time based information needed to key later availability.

Information Source

Staff skill/availability document (E1, p. 10), (A3, p. 10).

OBJECTIVES REQUIRE PREREQUISITE
(A1, p. 3)

Program Function

Program objectives may require specific prerequisites over and above the general requirements for program entry (C1, p. 1). This program element insures that specific skills, some of which may be acquired during the training sequence of a particular student, essential to a given objective exist.

Information Utilization

Specific prerequisites are the basis for the testing operation carried out during diagnosis of the student (C1, p. 1). The listing of prerequisites - keyed to objectives - is a basic list against which the tested skills of the student are matched.

Information Source

In early stages of program development, objective prerequisites are attached to each objective by program writers. Later student entry skills are matched to objective performance (B1, p. 7) to determine prerequisites emperically.

REMEDIAL WORK
(A1, p. 4)

Program Function

Provides for special instructional services to meet student deficiencies which are not of sufficient frequency to warrant inclusion in the normal sequence of objectives.

Information Utilization

Used as determinant of student program path (see Program Objective File). Available remedies for prerequisite skill deficiency can be offered to keep the student in a program path. If no remedy is available, the student must be re-routed through alternate program paths or his training terminated. High frequency of prerequisite failure is a signal to program developers of an instructional need.

Information Source

Available remedies are stored along with other objectives in the Program Objectives File.

OBJECTIVE AVAILABLE
(B3, p. 4)

Program Function

Matches total list of student desired objectives with those currently available. Used as a control on student assignment to objectives.

Information Utilization

Currently available objectives are matched to the list of student desired objectives resulting from the diagnostic procedure (B3, p. 4). Matched objectives go to implementation (A1, p. 5). Objectives not currently available are held for later assignment (C3, p. 4).

Information Source

Objective availability is determined by administrative considerations such as the state of program development and program priorities.

COLLECT FEES
(B1, p. 4)
(B1, p. 5)

Program Function

In the present conception of the training operation, student payment is not contingent on the preformance of the training organization - that is, training outcomes are not guaranteed. Fees are either payable in advance of training or arrangements must be made for subsequent payment.

Information Utilization

Fiscal clearance, either in the form of accounts paid or deferred payment approval, (B4, p. 12) is used as a hold on program assignment of the student.

Information Source

Student account (B4, p. 12) is keyed to objectives, If objective to be assigned has been paid, instruction can proceed. Procedures for deferred payment are in need of development.

CLASS SIZE
(C1, p. 5)

Program Function

One of several constraints on use of training resources. This control insures that those training sequences which require minimum enrollments for operation will be held until such minimums are met. The activation of such a hold for an individual student is done through the use of a flag on associated objectives in the student's file (C2, p. 5).

Information Utilization

Class size information is hold in storage and, upon aggregation of minimum enrollment level, used to activate a particular instructional sequence. Notice of holds on student progress due to inadequate enrollment is also given to students.

Information Source

Class size controls are generated in program development and are keyed to instructional objectives (see Program Objective File).

TRAINING ORDER
(D2, p. 5)

Program Function

Many sequences of objectives in the program paths exhibit hierarchical dependencies (see Program Objectives File). If a student cannot be given instruction (objective blocked) due to resource/staff constraints, he cannot continue with other objectives until it is known that the blocked objective is not essential to his instructional plan.

Information Utilization

Information regarding the hierarchical dependency of objectives is used in searching the student's program plan. A blocked objective activates a search of the student plan to determine possible objectives which can be pursued without completion of the blocked objective.

Information Source

Training order is initially determined by program designers. As large numbers of students complete programs, their records can be analyzed in order to determine training order emperically.

OBJECTIVE CREDIT
(A1, p. 6)

Program Function

The individualized program demands that the student be trained only in skills he does not currently possess. This means that he may demonstrate proficiency in any objective by some testing procedure. A successful performance on such test may result in some form of credit being given him by the training organization.

Information Utilization

Two classes of information are used in making the credit determination:

a) student performance on some demonstration or test of the objective.
b) a payoff table which indicates credit given by the training organization (or other institutions) for demonstrated skill.

Credit determination is made by direct comparison of the student's performance with the credit payoff table (Criteria Met B3, p. 6).

Information Source

Performance criteria for credit are the same as criteria set for mastery of each objective (B1, p. 7) or can be derived from these criteria. The credit payoff table must be developed by the training organization and/or other credit granting agencies.

PERFORMANCE CRITERIA
(B1, p. 7)

Program Function

Serves as idication of additional skill increments for students. Permanent records of criterion performance is used in program evaluation to determine relationship of student criterion levels to subsequent performance. Successful criterion performance by students also signal possible reinforcement operations in the instruction sequence (see Reinforcement of Student Responses).

Information Utilization

Two classes of information are used in determining criterion performance:

a) the value of the student's performance on the measurement of the objective.
b) the previously specified criterion level established for mastery of the objective.

These values are directly compared and the student passed into a performance diagnosis routine (C1, p. 7) for faulure to meet or exceed criterion level.

Information Source

The Program Objectives File contains a measurement operation for each objective. This file also has criterion levels specified for each objective. Initially, levels are determined by program writers. Later, student performance can be analyzed to determine functional relationships between performance levels and subsequent training and/or job behavior.

EVALUATE PERFORMANCE
(C1, p. 7)

Program Function

The performance of students who do not meet program criteria is an important source of information for program development and modification. The goal of program writers is a series of programs which insure attainment of mastery performance by all students who possess prerequisite skills. Therefore, performance failures must be examined to determine program weaknesses and possible student motivational variables.

Information Utilization

Information regarding student performance keyed to specific objectives is used to analyze portions of the training sequence to correct instructional errors. Reports on student motivation is used in programs where systematic reinforcement of student responses is attempted.

Information Source

Student performance information is derived directly from the various criterion examinations (B1, p. 1). Performance is keyed to the instructional sequence through the Program Objectives File. Student motivational variables are determined by inference from patterns of effort on objectives (E1, p. 1) and by direct report of behavior in the training setting.

STUDENT FILE
(A3, p. 7)

Program Function

The student file is a permanent record of performance in the training organization. It is the source of information for placement of the trainee and contains the list of objectives he has mastered.

Information Utilization

The student file may contain the original listing of objectives the student plans to meet during training (E1, p. 1). This listing can then be credited with completions and potential role designations (see Program Objectives File). Print-out of student file content can be forwarded directly to employers as part of the placement function.

Information Source

Information concerning total program for the student is derived from the Student Training Objectives (E1, p. 1). File up-dating takes place upon the completion of an objective at the criterion level of performance (B2, p. 7).

ALTERNATE CHOICE
(B1, p. 8)

Program Function

Students who fail to meet performance criteria for an objective and cannot have that failure remedied may have alternate program paths yet available to them (see Program Objectives File). At this point in the flow of events, the completed objectives of the student are searched to determine hierarchical dependencies among objectives which he may still meet. These dependencies, in turn, identify program paths open to the student.

Information Utilization

The Student File (A3, p. 7) is examined for completed objectives. Completed objectives are compared against the Program Objectives File to determine program paths open to the student. These options are made known to the student and he is recycled to (B1, p. 6).

Information Source

Completed objectives are listed in the Student File (B2, p. 7). Program Paths are stored in the Program Objectives File.

REFUND CHECK
(F1, p. 9)

Program Function

By making a refund of a portion of the fee paid for an instructional sequence available to the student on completion, a motivational factor may be introduced into instruction. This may be necessary especially if the training organization does not make use of other reinforcement practices (see Reinforcement of Student Responses). Refund can also be supported from the standpoint of program development as completed courses or sequences provide important data for program change.

Information Utilization

A simple decision rule is needed which signals the printing of the refund check upon completion of an objective at the specified criterion level. This feature of the program must be integrated with the student account to prevent administrative complexity in program accounts (see p. 12).

Information Source

The basic decision rule must be determined by program developers and administrators. The rule may later by refined based on the findings of reinforcement studies carried out by program staff.

RECRUIT STAFF
(C1, p. 10)

Program Function

Human resources are used by the training organization for instruction, course development (including research) and cross-training of other staff members. Persons may or may not be full-time staff members of the organization. Recruitment must take into account the priority order of training objectives (B1, p. 10) and the availability of staff members (A3, p. 10).

Information Utilization

Training objectives desired by the organization determine the time pattern of staff needs. The recruitment effort must include procedures whereby sources of staff may be searched for possible contributors. It is likely that this activity can be organized and controlled by the use of a suitable file for recruitment.

Information Source

Objectives to be met by recruitment are determined by the priority order put on program objectives by writers and administrators. Information on possible contributors could be collected by a suitable instrument which prospective staff members could complete. These data would be input to the file of objectives which could be taught (E1, p. 10).

COURSE DEVELOPMENT
(A1, p. 11)

Program Function

As program objectives are identified and available instructional sequences searched, it may become necessary for new sequences to be developed. These needs are met by retaining staff for the development and research of specific programs or for general work in this area of activity.

Information Utilization

The file of objectives which can be taught (F1, p. 10) is compared against needed course development. The matched individuals are compared against availability information (A3, p. 10) to result in offers of employment.

Information Source

Staff information is derived from teachable objectives (E1, p. 10) and from availability information (A3, p. 10). Course objectives in need of development are those for which no resources are on hand or available (A1, p. 2).

CROSS TRAINING
(B1, p. 11,

Program Function

Several of the skills needed by program staff members may be taught by other staff present or available. Such cross-training may be desirable if a large number of programmed lessons must be written and a person can be hired to teach staff members programming skills.

Information Utilization

Common training needs can be derived from the Program Objectives File. Specific staff inputs can be identified in the Objectives Teachable File (E1, p. 10). These are matched to isolate corss-training needs.

Information Source

Cross-training potential is derived from Objectives Teachable (E1, p. 10) and from Availability Information (A3, p. 10). Needs for staff training are inferred from the Program Objectives File.

ACCOUNTS RECEIVABLE (p. 12-13)

There are many applications that can be used in handling accounts receivable: basic accounting principles do not change. However, the basic records used in accounts receivable are the account record, statement, credit listing, and collections follow-up. Exact forms for these records are dependent upon the nature of the business enterprise. Information for these records are taken from invoices showing charges for inventory items sold or services rendered. Credit memoranda show allowances such as refunds. Pages 12-13 show a flow-chart of a typical accounts receivable procedure applicable to the present management system.

ACCOUNTS PAYABLE (p. 14-15)

Accounts payable applications must provide complete information that reveals purchases from one or groups of vendors. A purchase journal is a general necessity (invoice or voucher) register). Pages 14-15 outline a flow-chart of an accounts payable procedure which functions on a monthly cycle and which applies to the present management system.

The general procedure involves the following steps:

1. Audit of invoices for payment.
2. Posting of cash discounts if any.
3. Batch total establishment for control.
4. Posting to purchase journals.
5. Preparation of remittance documents.
6. Posting to disbursement journals.
7. Transmittal of remittance to vendor.

GENERAL PAYROLL (p. 16-18)

Payroll management has both a processing and reporting function. Both must be flexible. Pages 16-18 show a flow-chart of a typical payroll procedure which would apply to the present system. Questions that need to be answered during processing include:

1. Is this the proper record?
2. Has the maximum social security deduction been reached?
3. Are any additional earnings due?
4. What deductions need to be made?

The reporting function generates summations of the following type which apply to a cost effective management system:

1. Total earnings disbursement
2. Total federal taxes
3. Total state taxes
4. Total for bonds deducted
5. Total for social security
6. Year to date quarter totals
7. Vacation payments
8. Sick leave accounting

INVENTORY CONTROL (p. 19-20)

Inventory is defined as an itemized list of current goods or assests. Statistics show that approximately one-third to one-half of a firm's total assets may be invested in its inventory. A small percentage reduction in the level of inventory required may therefore release a sizeable amount of capital.

Inventory control offers the only feasible way in which a decentralized inventory can remain constant and under control. Computer control removes much of the guesswork that otherwise results.

For each item in inventory the computer may be programmed to:

1. Predict tends of use.
2. Track present stock levels.
3. Record use or no use data for projection.

Statistical evaluation of data has shown that 13 cents of each sales dollar is spent in physical movement and storage of inventory. If the data relative to inventory is controlled through an adequate management system shipping, handling, and storage costs may be reduced.

The determination of Economic Order Quantity (EOQ) for a given item may be programmed to provide cost effective results in an area which involves up to one-half of a firms total assets. EOQ procedures thus provide for the accumulation of data which:

1. Predict further demands on resources.
2. Describe the rate of resource use.
3. Determine when new orders should be placed.
4. Define how much should be ordered in terms of the most advantageious quantity for procurement and storage.
5. Gives information that determines if reorder quantities should be adjusted.

Pages 19-20 show a flow-chart of a typical contrcl system for resources and economic order quantity calculations.

Part 6 - REINFORCEMENT OF STUDENT RESPONSES:

A Management Option

In training programs designed to prepare individuals for specific organizational roles, a guide on the job or practicum experience can play an important part in preparing the trainee for the demands of his role. The practicum provides opportunities for synthesis of various aspects of training and for the application of newly acquired skills to practical problems. Consequently, the practicum is an important option to be considered in instructional management systems of the type discussed here.

The practicum can be viewed in one of two ways. It can be directly included in planned instructional sequences. In this use, the practicum is treated like other instruction objectives and is subject to the control of the objectives file. The practicum can, however, be treated as a reinforcement for student performance. Here the practicum is a consequence of attainment of objectives by a student. The student gains access to the practicum through instructional management sets and controls contingencies (Homme, 1968). These two uses of the practicum are discussed below.

1) The Practicum and Training Synthesis:

The over-all objective of training programs is to bring about responses in the student and to insure that events (stimuli) in the work setting will occasion and reinforce those responses. The practicum experience can be a training opportunity to bring specific student behavior under control of events which surround the role he is training to fill. Thus, training objectives can

be written for the practicum according to the format suggested in Part 3 of this paper.

A difficult problem in this use of the practicum is that of the proper sequence of practicum objectives in the total training pattern. Obviously, responses to be utilized by the student in the practicum must first be developed through training activities. It is not clear, however, that there are optimum collections of skills essential to effective practicum experiences. This is a question which can only be answered by systematic study of learning patterns as related to on the job performance. The same can be said for the length of the practicum experience. This has generally been adjusted to employment practices of receiving organizations. If we treat the practicum as a part of the instructional sequence, it will be necessary to accommodate varying arrangements for the practicum based on student movement through objectives.

2) The Practicum As Reinforcement:

Reinforcement practices for establishing student responses is a major omission in the management plan discussed in this paper. No specific provision has been made to provide reinforcement for newly acquired student behavior. Several options are suggested in the management plan - such as direct refund of student fees for successful completion (Flowcharts, p. 9) - none of these can be easily related to those reinforcers which will characterize the employment setting where the student will apply skills acquired in the training program.

As an attempt to meet the need for reinforcement of instruction Keller and his associates (Ferster and Perrott, 1968) have used social interaction between student and teacher as reinforcement for learned behavior. Students who acquire a particular set of responses are permitted to evaluate students of lesser accomplishment and to interact with instructors with increased frequency. In this system, contingencies are set which state the level of performance necessary to arrive at each of the available reinforcers. In general, the wider the choice of reinforcers, the more likely that each trainee will find consequences desirable to him and will, accordingly, devote considerable effort to acquiring the behaviors required in training (Premack, 1965).

Because the student has presumably entered training with the goal of a particular job in mind, there is some potential reinforcing value inherent in the job setting. By using the practicum (or internship) as a reinforcer we permit the student to sample available reinforcers on the job and maximize the probability that he will find reinforcers which will come to control his responses. He will also become aware of organizational reward practices and increase the liklihood that his training will correspond to available career paths (Galbraith, 1968).

If the practicum is to be used as a reinforcer for student behavior careful attention will have to be given to contingencies whereby the practicum is included in the student's program. That portion of the management flowchart (p. 7) related to the practi-

cum (internship) will require documentation and decision rules to meet this need. At the same time, research must be done on optimum location of the practicum in the training sequence and the potential reinforcing value of various experiences investigated.

Part 7 - SYSTEM EVALUATION

Decisions regarding the form and function of the management system are based on the degree to which the system meets its design objectives. The eleven objectives stated in Part 1 of this paper contain the standards against which the proposed management system must be evaluated. Each of the design objectives are re-stated below along with evaluation procedures needed to determine the performance of the management system.

> Objective 1 - "The goals of learning are specified in terms of observable student behavior and the conditions under which this behavior is to be exercised."

This objective states a quality control problem for the Objectives File. New objectives are not to be admitted to the File unless they contain conditions for learner behavior, specific behavioral actions to be carried out and measures of those actions. Evaluation, therefore, is carried out by establishing a procedure for sampling of the content of the Objectives File on a periodic basis and comparing the resulting sample of objectives against the above standards. Due to the importance of the File in the management system, the presence of any objectives not meeting standards in the sample is indication of need for change in system procedures.

> Objective 2 - "Diagnosis is made of the initial capabilities with which the learner begins a particular course of instruction. The capabilities that are assessed are those relevant to the forthcoming instruction."

In the preceding discussion, learner capabilities are expanded to include diagnosis of roles which the individual may

train for during instruction. Insofar as capabilities of the learner are concerned, evaluation must match the diagnostic procedure against prerequisites listed for the objectives on file. This is a sampling - comparison problem. Samples of objectives are chosen from the File and their prerequisites compared with the range of information gathered in diagnosis. Only a relatively small proportion of unmatched diagnostic items can be permitted; the magnitude of this proportion can be statistically determined as a part of the sampling design.

The minimum condition for a satisfactory role diagnosis is a student program of instruction whose objectives match entry requisites for a desired role or roles. The evaluation question to be answered, 'Have all objectives on file which apply to roles desired by the student been identified in diagnosis?'. According to the answer to this question program content may be altered or the diagnostic procedure modified.

> Objective 3 - "Educational alternatives adaptive to the initial profile of the student are presented to him. The student selects or is assigned one of these alternatives."

Evaluation of this objective is an extension of the assessments made in Objective 2 above. In that case the student was presented with the pattern of instructional objectives which would qualify him for specific roles for which he wished to be trained. In this objective we wish to expand the student's options to include other roles yet unknown to (or unconsidered by) him. The minimum condition for a positive evaluation of Objective 3 is at least one sequence of instructional objectives available to him which is not part of the program path to his stated role goal.

By sampling student programs, evaluators can compare alternatives presented him with his stated goals. These alternatives should state known roles for which he may train along with the sequence of objectives he should pursue in order to qualify for those roles. Such presentation should also be made following completion of sub-routines or sequences during the period he is in training. These alternatives should be listed in descending order to indicate choices of objectives which lead to maximum numbers of role qualifications upon completion of training.

Objective 4 - "Student performance is monitored and continuously assessed as the student proceeds to learn."

In the proposed management system, the completion of a given objective by the student is a signal for performance evaluation which results in a re-assessment of study options open to him. Attainment of the objective is determined by taking a sample of students and analyzing their program path. If the student is asked to indicate his interest in new training sequences periodically, the objective is being met.

In addition to feedback of instructional results to students, information must be gathered regarding student performance on each instructional objective. This results in summary achievement data on each objective which can be used to assess effectiveness of instructional procedures. This aspect of monitoring is discussed under Objective 6 below.

Objective 5 - "Instruction proceeds as a function of the relationship between measures of student performance, available instructional alternatives and criteria of competence."

This objective can only be judged in a qualitative manner. The practices of those engaged in instruction can be analyzed to determine the degree to which indicators of the above dimensions of instruction are used in making decisions relating to student progress, instructional methods and training content. If instruction is managed largely through the use of computers, the decision tables stored in the computer can be studied to determine the use of the above indicators. In cases of human management of instruction, sample decisions would have to be evaluated against the content and intent of Objective 5.

Objective 6 - "As instruction proceeds, data are generated for monitoring and improving the instructional system."

The several decisions related to monitoring of the instructional system have been discussed above. In addition to these monitoring or operating decisions, there are several aspects of instruction which must be studied in a research mode in order that this objective be attained. Two areas of concern central to system operation are: 1) sequence and spacing of instructional objectives and 2) articulation of training and practicum or internship experiences.

In order to attain Objective 6, the management system must provide for continued study of training sequences used in the program. Empirical tests should be made of alternate sequence patterns as related to student performance both during and subsequent to training. The system must also analyze instructional objectives used from the standpoint of a 'unit of work' for students. As discussed in the section treating the Objectives

File (Part 2) this would involve study of objectives and student performance as a multidimensional scaling problem.

The practicum experience should also be studied. It must be analyzed as to its effectiveness as a means to attaining instructional objectives. If the practicum is used as reinforcement for student performance (see Part 6) various plans for administration of the practicum experience must be tested against demonstrated student learnings.

Objective 7 - "Knowledge and skills available to trainees are modular in nature and can be aggreated to meet demands of particular employee roles."

The patterns of objectives evidenced in student programs constitute the measurement of this objective. The greater the variability in the objectives comprising programs, the greater the liklihood that some form of instructional module is being used. To further evaluate this objective, it is necessary to compare the programs of students who are in training for identical or similar roles. The programs of these students should show greater similarity in objectives included than would be the case for the programs of students chosen at random from the population of trainees.

The aggregation of objectives (or learning modules) to complete role training is facilitated by the structure of the Objectives File (Part 2). The File must identify program or role paths open to the student. Programs of study which make use of identical objectives should also make use of identical instructional modules if the above objective is to be realized.

Objective 8 - "Follow-up data on trainee performance on the job is gathered and used to revise and update training program content."

This objective is closely related to the over-all objectives of the training program. Those objectives should state the on-the-job performances which are to be realized by trainees. Then, the evaluation of this objective is carried out by examining the degree to which on the job data is used to revise instructional content or practice.

If the program Objectives File has rules or procedures for adding or changing file content, the evaluation of Objective 8 is furthered. A sample of objectives can be drawn and revision noted. If revisions are drawn out of on-the-job follow-up data, then the objective is being met.

Objective 9 - "Students may enter and leave the program at any point. Enter/leave decisions are controlled by trainee characteristics and desired skill/knowledge outcomes."

Evaluation of this objective is a two-part problem. First, the determination of flexibility in entering and leaving the program must be made. This is done by examining the pattern of study of a sample of students. Objective 9 is being met if the exhibited patterns show variable entry dates and if students have left programs to return at a later date.

Second, the rationale for enter/leave decisions must be examined. These decisions should be based on the desired objectives of students as derived from the diagnostic interview given students at entry. Prerequisites present at the time of entry should permit a student to take advanced objectives in the program. Similarly, the role or roles for which he wishes to

prepare should signal his exit from study. Evaluators must again examine the program patterns of a sample of students and match program decisions to the data derived from the diagnostic interview.

> Objective 10 - "Certification and/or credit is an optional feature of the program. Decision rules are available to insure wide interpretation of program content across receiving organizations."

The presence or absence of the above decision rules can be readily ascertained by examining the various program data files. The suitability of the decision rules can, in turn, be determined by examining the employment history of a sample of students. If students are not being denied employment or credit or certification grounds, the objective is being met.

> Objective 11 - "Student performance - both during training and subsequent to training - constitutes the measurement operation for program evaluation. It also produces a baseline of performance against which instructional innovations can be judged."

This is a complex objective in that it is a statement against which the evaluation of program objectives can itself be evaluated. It implies that over-all program objectives will be stated in terms of student performance. Effective evaluation will then employ data on student action to determine the attainment of program objectives.

The data on student performance is also to be used to assess the effectiveness of alternate learning designs. This can be measured by examining decisions related to instruction materials and practices and assessing the degree to which these decisions are

based on student performance. It is, of course, implied that gains in student performance brought about by instruction alternatives will be judged on a cost-benefit basis.

Part 8 - MANAGEMENT SYSTEM BIBLIOGRAPHY

Wm. W. Cooley, and Robert Glaser, "An Information and Management System for Individually Prescribed Instruction," (Univ. of Pittsburgh, Learning Research and Development Center, 1968).

James Emery, Organizational Planning and Control Systems, (New York: Macmillan, 1969).

Charles Ferster, and Mary Perrott, Behavior Principles, (New York: Appleton, Century & Croft, 1968).

Jay R. Galbraith, "Path Goal Models as a Basis for the Design of Organization Reward Systems," (Paper presented at 1968 convention of American Psychological Association).

Chadwick J. Haberstroch, "Control as an Organizational Process," Management Science, 6, January, 1960, pp. 165-171.

Richard E. Hill, "A Comprehensive Model of Aggregate Inventory Management," (University of Washington, Unpublished Doctor's Dissertation, 1969).

Lloyd Homme, et. al., "What Behavioral Engineering Is," Psychological Record, 1968, V. 18, No. 3, pp. 425-434.

IBM, General Information Manual, (Poughkeepsie, New York: IBM, 1962).

Roy M. Jenevein, et. al., "A Computerized Stockroom," Journal of Chemical Education, V. 45, No. 2, February 1968, pp. 132-135.

Daniel Katz, and Robert Kahn, The Social Psychology of Organizations, (New York: J. Wiley, 1966).

Robert F. Mager, Preparing Instructional Objectives, (San Francisco: Fearon, 1962).

David Premack, "Reinforcement Theory," Nebraska Symposium on Motivation, D. Levine (ed.), (University of Nebraska Press, 1965, pp. 123-188).

Willard M. Reineck, "Replacement of School Equipment," (Los Angeles, University of California. Unpublished Ed.D. Dissertation, 1968).

Joe Silverman, "A Computer Technique for Clustering Tasks," Technical Bulletin, 66-23, (San Diego, Naval Personnel Research Activity, 1966).

UMREL, "Contractor Request for Continued Funding," (Minneapolis, Minnesota, 1970).

Margaret Wang, "An Investigation of Selected Procedures for Measuring and Predicting Rate of Learning in Classrooms Operating Under a Program of Individualized Instruction," (Pittsburgh University, School of Education, 1968).

APPENDIX I

FORMAT FOR WRITING EDUCATIONAL OBJECTIVES

by Marvin Daley and Lanny Morreau
of the UMREL staff

"If we are to study an educational program systematically and intelligently we must first be sure as to the educational objectives aimed at."

--Ralph W. Tyler
in Basic Principles of
Curriculum and Instruction

The objective of this research training program is to develop a competent educational researcher. To do this it is necessary to identify those classes of behavior which must be present in the researcher's repertoire and to construct a program which insures that the candidates will acquire the necessary behavior. Planning for this program should provide 1) a sequential development scheme for the candidates, 2) a systematic measurement procedure for evaluating program effects, 3) the collection of data for continuous modification and improvement of the program itself, and 4) procedures for disseminating the model and the candidates into the educational community.

Central to the plan is a precise statement of the program objectives--"goals for or desired outcomes of the learning expressed in terms of the learner's observable behavior" (Montague and Butts, 1968), including the specific behavioral/measureable event, the conditions under which this event will occur, and the criteria by which it can be judged (Mager).

When an instructional program is planned around precise instructional objectives, the following benefits result: 1) curriculum materials can be selected to meet specific objectives (Gagne, p. 24),

2) curriculum materials can be modified through the analysis of learner responses, 3) the learner's placement in a learning sequence can be based upon his present behavioral repertoire, 4) learning experiences can be sequenced on a continuum to enable the learner to emit the desired terminal response in the appropriate real-life situations, 5) the instructor can specify the precise conditions under which the learner should be reinforced (Gagne; Engman), 6) redundant or irrelevant behavior and material can be eliminated from the continuum while insuring that no precurrent skills are omitted, 7) the learner's progress can be empirically assessed, 8) training time can be reduced (Mager and McCann, 1961), 9) measures for program success can be based on postulated program outcomes (Burns, 1968), 10) precise communication of program objectives to the learner, the instructor, and other professionals is assured, 11) a baseline of learner responses can be developed for the evaluation of further modifications (Gagne), and 12) the total program can be evaluated by independent observers.

Since there exist no sequentially arranged behavioral objectives for preparing a candidate in this field, it becomes necessary for the program planners to generate a sequence of objectives which meet the criteria of measureability and communicability. Development of this sequence of instructional objectives can be greatly facilitated by:

1. use of a consistent language system for stating objectives,
2. selection of alternate activities and materials for each objective,
3. use of a model computer storage/retrieval system for access to these objectives,

4. development of a design for evaluation of the objectives.

Use of a consistent language system

The following behavioral model provides the consistent language system necessary for writing instructional objectives. This model requires that the program planner ask how the objectives can be met, in what format the objectives will be most useable, and how access to the objectives can be made quick and easy.

A. the statement of a conceptual objective, -- the generalized goal or outcome of the total program.

B. the statement of an educational objective, -- a delineation of the conceptual objective stating general categories of skill/ knowledge required to meet that objective.

C. the statement of an instructional objective, -- the specific classes of behavior which are included in each educational objective. The precision necessary for describing behavior at this level can be obtained through the use of Sullivan's synthesis of basic action terms: "identify, name, describe, construct, order and demonstrate and the subset of behavioral objective verbs accompanying it." (AAAS)

D. the statement of the behavioral objective, -- the terminal outcome of the program as specified by this five-part division:

1. the individual learner -- the specification of the learner as differentiated from a class or group of learners. (All objectives must be written with the assumption that an individual learner will be meeting that objective, therefore, the phrase, "the learner" can be omitted from the statement itself.)
2. action -- a specific measureable response which the learner will emit. Using the category framework.

"- identify, name, describe, construct, order, and demonstrate" - the action will specify the precise observable behaviors which are necessary for meeting the educational objective.

3. stimulus condition -- a delineation of the stimulus conditions under which the response will occur. These conditions will relate to three general classes: a) the environmental conditions present, e.g., using only a digital computer, b) the history of the learner, e.g., after completing module one and two, and c) type and quantity of a particular stimulus event, e.g., when presented with three problems in factor analysis.

4. measure -- a specific statement of the frequency, duration, or quality of the response. The measurement operation incorporates one of these units, a combination of the units, or a derivative from these units.

5. criteria -- the level of accuracy at which the response will be emitted. This level must be related to the terminal level of competence required for independent functioning. Criteria for success must be based on the behavior of the successful educational research currently in the field.

Alternate activities and materials

Each objective should be accompanied by alternate media, activity, and environmental possibilities (Kapfer) which the instructor or the learner can select to meet his individual needs. Each objective

should be cast in a systematic format which provides an abstract of the key components of the objective indexed to the classification scheme described in this paper (Fig. 1).

Figure 1

MODEL FOR INSTRUCTIONAL OBJECTIVES FORMAT

Instructional Objectives for _____

Educational Objectives	Instructional Objectives	Index#	INSTRUCTIONAL OBJECTIVE			Evaluative Procedure		Instructions for Instructor	Sample Item	Suggested Media Materials
			Condition	Action	Measure					

Model computer storage retrieval system

Teachers have difficulty in managing even a limited number of specified objectives (Eisner, 1966), let alone the hundreds which would be required to prepare a researcher. A computer storage/retrieval system appears to be imperative for instructor and learner access to the thousands of objectives which will be met by the trainee. Several cataloging systems for elementary curriculum objectives have been developed over the past three years. (UMREL, IOX, Clark County) Comparable cataloging systems have also been developed for use at the college level - (Ohio and SWSC) demonstrating that the banking of objectives in the present case is not only possible, but is also practical. An objectives bank using the technology and hardware provided by computer services will not only provide rapid access to objectives but will also serve to eliminate redundancy, provide reporting of student progress by objectives met, supply data on the effectiveness of specific materials in leading to the desired terminal behavior, and enable researchers to investigate the effects of independent variables on student behavior.

Evaluation of the objectives

An objectives based program provides its own criteria for evaluation. Responses to the following sequence of questions (based upon the behavioral model) provide the program developer with an initial evaluation of the adequacy of his objectives. Conceptual Objective: Does the Conceptual Objective accurately state the expected outcomes of the program? Educational Objective:

Have all classes of behavior necessary for successful educational research been included? Have any classes of behaviors non-relevant to the successful educational research been included? Instructional Objective: Have all behaviors encompassed in the educational objectives been included? Behavioral Objective: Can the behavior be emitted by an individual learner? Is the action observable? Is the action measurable? Have the specific limitations of stimulus conditions for that action been stated? Has a specific quantity, quality, or duration for each action been specified? Does each behavioral objective lead directly to the meeting of one or more educational objectives? Are the suggested instructional materials directly related to the meeting of this objective: Have all pre-current skills for meeting the objective been delineated and completed? General: Is the language system consistent throughout the objectives? Can analysis and revision procedures be prepared consistent with the stated objectives?

The objectives based program also provides information for modification based upon this analysis. Failure to realize the conceptual objectives of the program can result from unrealistic or incomplete writing of instructional objectives or sequences of objectives, inadequate placement of the trainee in the sequence, the selection of inappropriate activities, media, or materials, or the use of inadequate/inconsistent evaluation devices. Since the program is based on objectives and a terminal product has been specified, any of these deficiencies can be corrected and the objectives re-evaluated.

BIBLIOGRAPHY

Atkin, J. M., "Behavioral objectives in curriculum design: A cautionary note," The Science Teacher, May 1968, 27-30.

Baker, E. L., "The differential effect of behavioral and non-behavioral objectives given to teachers on the achievement of their students," Interim Report, August 1967, University of California, Los Angeles, Contract Nonr OE-6-10-254, U. S. Department of Health, Education and Welfare.

Baker, R. L., Gerlach, V. S. and Sullivan, H. J., Constructing Behavioral Objectives. Inglewood, California: Southwest Regional Laboratory for Educational Research and Development, 1968.

Beck, J., and Shaw, W. A., "Learning and teaching: An analysis and characterization," Psychological Report, 1960, 7(3) 543-553.

Bloom, B., et. al. (Ed.), Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain, New York: Longman, Green and Company, 1956.

Burns, R. W., "Objectives and classroom instruction," Educational Technology, September 1967, 1-3.

Burns, R. W., "The theory of expressing objectives," Educational Technology, October 1967, 1-3.

Cox, R. C., "Item selection techniques and evaluation of instructional objectives," Journal of Educational Measurement, 1965, 2, 181-185.

Cresswell, D. E., and Berger, E., "The development of an information system for elementary school Mathematics Curriculum--a feasibility study," Final Report, November 1967, Pennsylvania State Department of Public Instruction, Contract No. OEC-6-10-352; ERIC No. ED015768, U. S. Department of Health, Education and Welfare.

Doherty, V. E., "Procedure for growth," Educational Leadership, December 1965, 247-251.

Edling, J. V., "Educational objectives and educational media," Review of Educational Research, Washington, D. C.: American Educational Research Association, 1968.

Eisner, E. E., "Educational objectives: Help or hinderance." Paper presented at the annual meeting of the American Educational Research Association, Chicago, February 1966.

Engman, B. D., "Behavioral objectives: Key to planning," The Science Teacher, 35(7), 86-87.

Esbensen, R., "Writing Instructional Objectives," Phi Delta Kappan, 1967, 48(5), 246-247.

Gagne, R. M., "The acquisition of knowledge," Psychological Review, 1962, 69(4), 355-365.

Gagne, R.M., "The analysis of instructional objectives for the design of instruction," In Glaser, R. (Ed.) Teaching Machines and Programmed Learning, II, Date and Decisions, Washington, D. C., Department of Audio Visual Instruction, National Education Association, 1965.

Gagne, R. M., "The implications of instructional objectives for learning," In R. A. Weisgerber (Ed.) Instructional Process and Media Innovations, New York: Rand McNally, 1968.

Gagne, R. M., "Learning Hierarchies," Paper presented at the meeting of Division 15, American Psychological Association, San Francisco, August 1968.

Gagne, R. M., and Paradise, N. E., "Abilities and learning sets in knowledge acquisition," Psychological Monographs, 1961, 75(4, Whole No. 518).

Garvey, J. F., "The what and why of behavioral objectives," Instructor, April 1968.

Gerlach, V. S., Describing Educational Outcomes, Inglewood, California: Southwest Regional Laboratory for Educational Research and Development, 1967.

Gideonse, H., "Behavioral objectives: Continuing the dialogue," The Science Teacher, 1969, 36(1), 51-54.

Glaser, R., "Instructional technology and the measurement of learning outcomes: Some questions," American Psychologist, 1963, 18, 519-521.

Goldman, H., and Pfluger, L. W., "Multiple curricula: A strategy for selection," Educational Leadership, April 1969, 688-692.

Johnson, S. R., Specifying and Analyzing Objectives. Durham, North Carolina: Regional Laboratory for the Carolinas and Virginia, 1965.

Kapfer, P. G., "Behavioral objectives and the curriculum processor," Educational Technology, May 1970, 14-17.

Krathwahl, D. R., "Stating objectives appropriately for program, for curriculum, and for instructional materials development," Journal of Teacher Education, 1965, 16, 83-92.

Krathwahl, D. R., Bloom, B. & Masia, B., Taxonomy of Educational Objectives: Handbook II: Affective domain, New York: David McKay Company, Inc., 1964.

Mager, R. F., Preparing Instructional Objectives, Palo Alto, California: Fearon Publishers, 1962.

Markle, S. M. and Tiemann, P. W., "Behavioral Analysis of 'Cognitive' Content," Educational Technology, January 1970, 41-45.

Montague, E. J. & Butts, D. P., "Behavioral Objectives," The Science Teacher, 1968, 35(3), 33-35.

Morreau, L. E., "A curriculum for every child," Behaviorally Engineered Environments: Staff papers for AERA Symposium, 1970, Minneapolis; Upper Midwest Regional Educational Laboratory, 1970.

Morreau, L. E., Programmed Text I: Instructional Objectives, Minneapolis, UMREL, 1970.

Popham, W. J., "The performance test: A new approach to the assessment of teaching proficiency," Journal of Teacher Education, Summer 1968, 19(2), 216-222.

Popham, W. J., "Potential uses of IOX objectives," Unpublished manuscript, The center for the study of evaluation, University of California, Los Angeles, January 1970.

Popham, W. J., "The instructional objectives exchange: progress and prospects," Symposium presented at American Educational Research Association, Minneapolis, Minnesota, March 1970.

Popham, W. J., and Baker, E. L., "The instructional objectives preference list," Journal of Educational Measurement, 1965, 2, 186.

Popham, W. J. and Baker, E. L., Establishing Instructional Goals, Englewood Cliffs, New Jersey: Prentice-Hall, 1970.

Popham, W. J. and Baker, E. L., Planning A Instructional Sequence, Englewood Cliffs, New Jersey: Prentice-Hall, 1970.

Popham, W. J. and Baker, E. L., Systematic Instruction, Englewood Cliffs, New Jersey: Prentice-Hall, 1970.

Tabers, J. I., Glaser, R. and Schaifer, H., Learning and Programmed Instruction, Reading, Mass.: Addison-Wesley Publishing Co., Inc., 1965.

Trow, C., "Behavioral objectives in education," Educational Technology, June 15, 1968, 6-10.

Tyler, L. L., and Okumu, L. J., "A beginning step: A system for analyzing courses in teacher education," Journal of Teacher Education, 1965, 16(4), 438-444.

Walbesser, Henry H., "Curriculum evaluation by means of behavioral objectives," Journal of Research in Science Teaching, 1963, 1, 296-301.

Wininger, R. A. and Publicover, R. G., "Full-service banking of objectives," Behaviorally Engineered Environments: Staff papers for AERA Symposium 1970. Minneapolis: Upper Midwest Regional Educational Laboratory, 1970.

Wolf, R. Review of R. P. Kropp and H. W. Stoker: "The Construction and Validation of Tests of the Cognitive Processes as Described in the Taxonomy of Educational Objectives," Educational and Psychological Measurement, 1967, 27, 542-548.

Yelon, S. L. and Scott, R. O., A Strategy for Writing Objectives, Dubuque, Iowa: Kendall/Hunt Publishing Company, 1970.